Intentional forgetting of emotional memories in the item-method directed forgetting task

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Sumera Ahmed BSc

To mum & Uncle T.

Abstract

Forgetting is often viewed as a nuisance, but research has indicated that forgetting is an adaptive process that works to remove irrelevant information (Bjork,1989). Such 'intentional' forgetting concerns the active removal of information from memory, with evidence coming from the Think/No-Think paradigm (Anderson & Green, 2004) and most importantly the Directed Forgetting paradigm (Bjork, 1970). The Directed Forgetting paradigm assesses intentional forgetting through the use of two cues (Remember and Forget) and a majority of studies suggest a successful inhibition of the 'Forget' items in comparison to the 'Remember' items. However, there is a long-term dispute within research in regard to valence and intentional forgetting. Specifically, it is unclear whether directed forgetting is reduced for emotional stimuli, in comparison to neutral stimuli.

In the current thesis, Directed Forgetting was tested in six experiments and consistently reported when retrieval was assessed through free recall. The Directed Forgetting effect also applied to emotional material. However, valence differences for the 'Remember' cue (positive vs negative) were greater than the differences found for the 'Forget' cue. This suggests that both positive and negative words can be successfully forgotten. Additionally, factors such as time (Chapters 2, 3 and 5), individual differences (Chapters 4 [sex differences] and 5 [mood and emotional reactivity]) and stimuli characteristics (Chapters 5 [concreteness] and 7 [word type]) had a minimal impact on Directed Forgetting.

The experiments within this thesis have been successful in highlighting DF within free recall. Yet when a cued recall procedure was used, the DF effect was abolished, and there actually seemed to be a form of inverted DF for negative words.

Lastly, limitations, theoretical implications and future directions are considered in Chapter 8 (the general discussion).

Contents

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Chapter 1: Introduction and literature review

1.1. Incidental Forgetting

Incidental forgetting is the notion of unintentionally losing information from memory (Anderson & Hanslmayr, 2014). Incidental forgetting may be due to interruptions at consolidation or encoding, which relate to theories such as interference (Oberauer & Lewandowsky, 2008), decay (Barrouillet, De Paepe, & Langerock, 2012), displacement (Waugh & Norman, 1965), retrieval-induced forgetting (Bjork, 1989; Storm & Angello, 2010) and so on.

The passage of time seems to be correlated with incidental forgetting. It has been argued that "Forgetting increases as time passes" (Baddeley, Eysenck & Anderson, 2015, p. 233) and to test this idea, one of the early studies was conducted by Ebbinghaus (1913). He tested himself by learning lists of nonsense syllables (169 lists, 13 nonsense syllables). Ebbinghaus learnt and relearnt each list with breaks lasting between 21 minutes and 31 days. His results indicated that there was forgetting, with initially rapid memory loss, suggesting a strong relationship between time and forgetting. Further studies have emulated this and found similar effects. For example, Meeter et al. (2005) had participants recall past public events and found that there was an initial 60% drop in recall. A further 30% drop was seen within a single year.

Further support for "time-dependent" forgetting was reported by Murre and Dross (2015), who replicated Ebbinghaus's (1913) study and showed a clear forgetting curve. This phenomenon is also evident within other studies (Bahrick et al., 1975; Hu et al., 2013), which generally indicate that forgetting follows a negatively accelerating function.

Incidental forgetting is part of a system that renders a memory 'unavailable' or 'inaccessible' at the time of recall. Thus, it can be argued that the passage of time weakens a memory trace (Baddeley et al., 2015). Whilst this unintentional forgetting can be frustrating, its wider benefits are shown in the case of AJ (Parker et al., 2006). Due to ‘hyperthymesia’, AJ has an exceptional autobiographical memory. Yet her ability to recall past events with such accuracy and being unable to forget was becoming a hindrance to AJ throughout her daily life. She would spend most of her time recalling memories and this became a problem for her day to day functioning and health. This suggests that forgetting has a useful and often unrecognised function, so if incidental forgetting can be valuable, then the ability to forget *deliberately* would be even more beneficial.

1.2. Intentional Forgetting

1.2.1. Explaining the phenomenon

Unlike incidental forgetting, intentional forgetting is considered to be an adaptive mechanism rather than a failure of memory (Bjork, 1989). For example, it could prevent irrelevant information from interfering with relevant and currently needed information (Wylie et al., 2008). An early demonstration of intentional forgetting was reported by Anderson and Green (2001), who found that avoiding a memory prevented any awareness of that memory at recall. Importantly, intentional forgetting is an active rather than passive process, which can be investigated in several different ways.

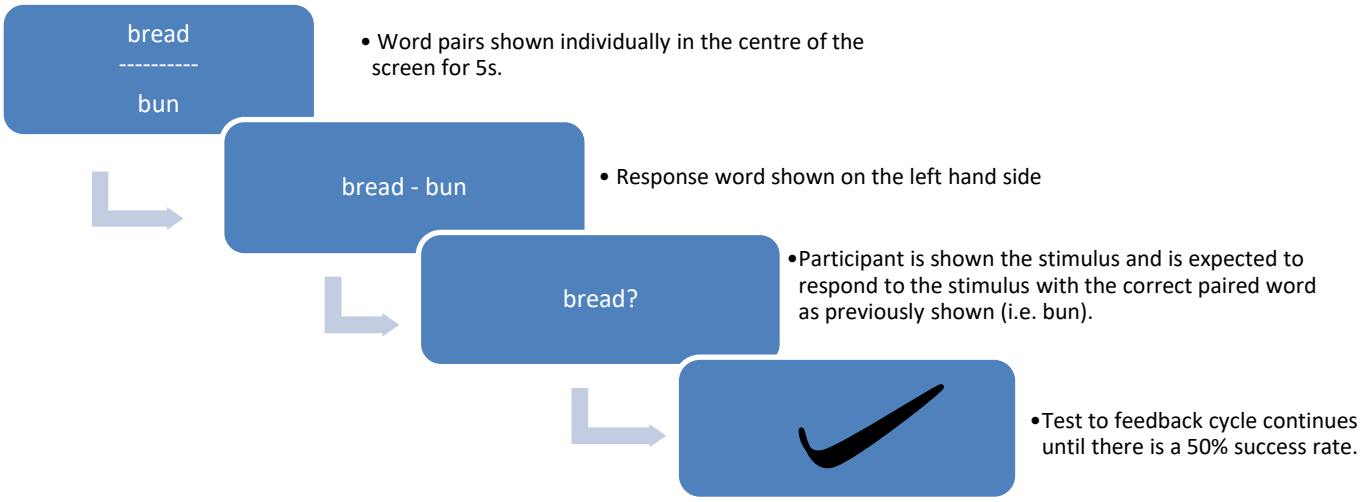
1.2.2 Methodologies of intentional Forgetting

1.2.2.1. Think/No-Think (TNT)

The first paradigm that specifically relates to intentional forgetting is the Think/No-Think paradigm (TNT; Anderson & Green, 2001). TNT comprises several stages, with an initial study phase starting the procedure. This phase includes several cycles of learning, usually of stimulus pairs, and once the participants can remember the pairs above a criterion, they move onto the TNT phase (as seen in Figure 1.1).

Figure 1.1.

Visual representation of the initial training phase.



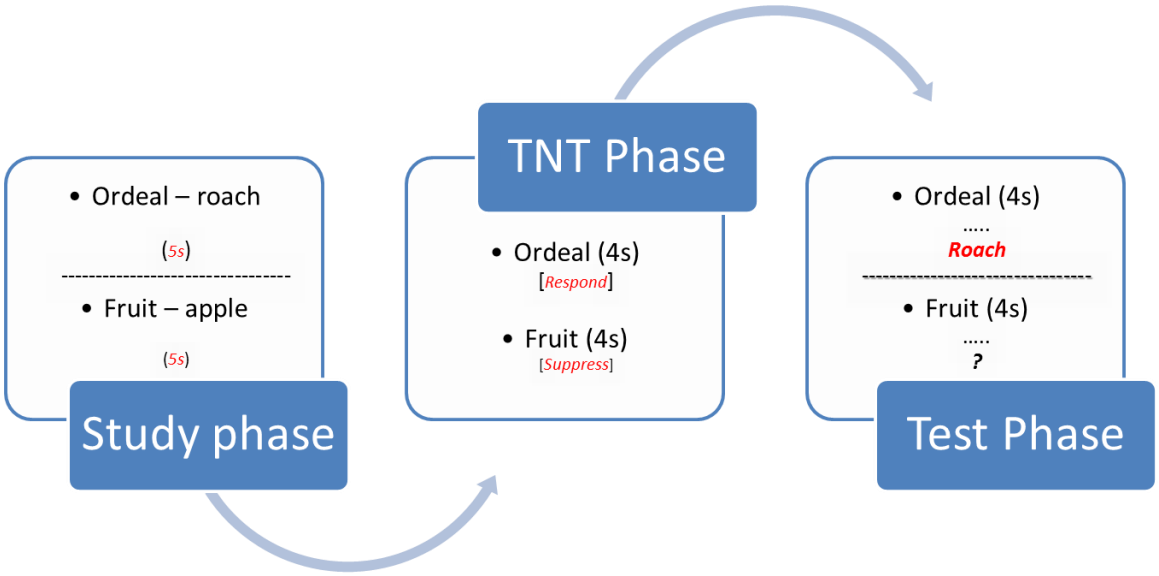
Note. This example presents word pairs, but other pairs can be used (e.g. face-image pairs).

As for the actual Think/No-Think phase, participants familiarise themselves with the stimuli in order to identify which stimuli need to be suppressed. There are three trials that are used within this phase: think, no-think and baseline. Based on the instruction, participants look at what needs to be suppressed or not from the

think and no-think trials, yet are not exposed to the baseline stimuli during this phase. After this, a test phase is used, in which participants see the first part of every pair from phase 1, and need to recall the associated item (as seen in Figure 1.2).

Figure 1.2.

Diagram to show the example stages of a TNT paradigm for both suppression (or "think") and respond (or "no-think") trials in a verbal memory task.

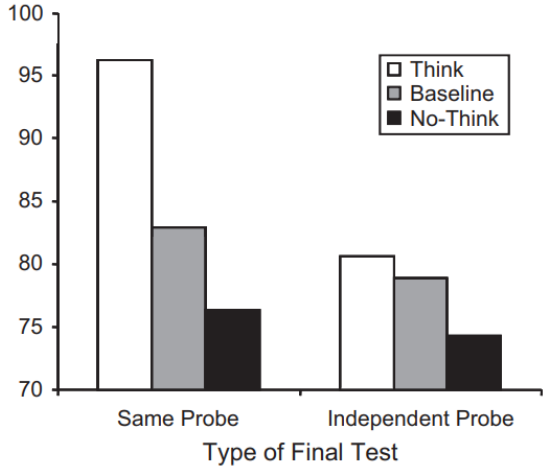


The results of Anderson and Green's (2001) study indicated that the suppressed (no-think) items were remembered less than the respond (think) items, showing evidence for intentional forgetting produced by underlying executive control processes (Anderson & Green, 2001). They found that during the test phase, baseline items are also more likely to be recalled than suppressed items, even though they were not experienced in the TNT phase. This is known as the negative control effect (see Figure 1.3). This negative control effect shows how the act of suppressing the no-think items impairs recall below the baseline items. Additionally,

Anderson and Green (2001) found that forgetting increased as the number of no-think attempts also increased. Adding incentives did not influence recall and Anderson and Green concluded that intentional forgetting is due to suppression.

Figure 1.3.

The percentage of items recalled according to whether participants recalled (think), suppressed (no-think) or had no reminders to the item (baseline) during the think/no-think phase.



Note. In the same probe condition, participants experienced the same stimuli as the study period whereas in the independent probe condition they had different probes with similar connotations to the original probes experienced during the study period. Figure adapted from Anderson and Levy (2009).

1.2.4. Directed Forgetting (DF)

Intentional forgetting can also be assessed using the 'Directed Forgetting' paradigm (DF; Bjork, 1970). Where the TNT paradigm (Anderson & Green, 2001) uses stimuli that are very well learnt, the DF paradigm does not. According to

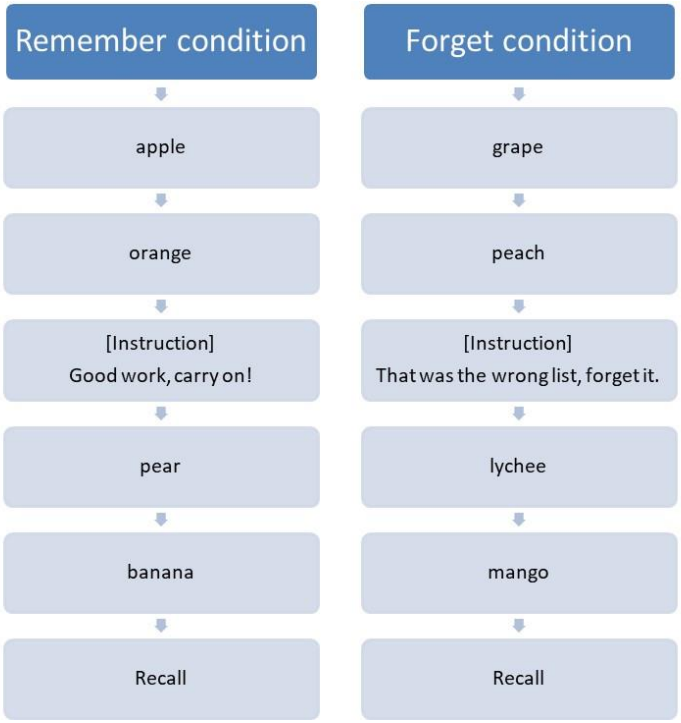
Sahakyan and Foster (2009), DF separates information in terms of relevance and irrelevance and assesses the effect on memory. The DF paradigm, much like the TNT paradigm, uses cues to indicate items that should be remembered or forgotten. However, there are two core DF methods – the 'list-method' and the 'item-method' (Bjork, 1989). Whilst both methods differ on the timing of the remember/forget instruction, their general goal is similar. The instructions take two forms – 'TBR' (To Be Remembered) and 'TBF' (To Be Forgotten) – and participants are told to remember the TBR items and forget TBF items. Yet during the retrieval phase participants are told to remember both 'TBR' and 'TBF' items (Bailey & Chapman, 2012). Stimuli within these methods are typically words (Dewhurst & Parry, 2000; Yang et al., 2012) or images (Brand et al., 2013; Ochsner, 2000), but can also include videos (Wang, 2015).

1.2.4.1. List-method

The list-method of DF uses two stimulus lists and two conditions. In one group, participants are told to remember both lists and recall all the stimuli at the end of the procedure (TBR condition). However, the second group is told to forget the first list (TBF condition) and only remember the second list. Yet in the final memory test, participants must remember items from both lists (Baddeley et al., 2015 [see Figure 1.4.).

Figure 1.4.

A visual representation of the 'List-method' of DF.



Note. Depending on the condition the participants are in, they are told to either remember or forget the first list, but at the end participants in both conditions must recall all stimuli.

Participants do better at recalling the second list when they are told to forget the first list, but the 'forget' instruction often impairs recall of the first list (Baddeley et al., 2015). As the instructions are not given until after the first list is presented, encoding is expected to take place (Baddeley et al., 2015) and the list-method thus looks at problems during retrieval. Additionally, the list-method has shown that the 'TBF' list items have more impact when memory is tested implicitly (Baddeley, et al., 2015). This was demonstrated by Bjork and Bjork (2003), who inserted names from

the 'TBF' category into a non-related test and found that the participants remembered the TBF names. However, participants could not remember where these names were initially from, suggesting that DF does occur, but it may also be suggested that rather than entirely forgetting information, the accessibility of the memory is just reduced (Baddeley et al., 2015).

1.2.4.2. Item-method

In contrast to the list-method, the item-method presents participants with individual stimuli that are immediately followed by a cue (either 'TBR' or 'TBF'). The cue instructs the participant to either remember the item or forget it. At the end of the task, a recall or recognition test for all items is conducted (as seen in Figure 1.5.). Here maintenance rehearsal can be used to keep the item in working memory until the instruction has been received. This then results in elaborative rehearsal for 'TBR' items or a dismissal/ inhibition for 'TBF' items (Wylie et al., 2008).

Figure 1.5.

A visual representation of the 'item-method' of DF where trials are randomised.

Note. Stimuli (words in this example) are associated with an instructional cue, with participants told to either remember (TBR) or forget (TBF) each stimulus. At the end of the list the participant is required to retrieve all stimuli regardless of the cue (here a recall test is used, but recognition is common too).

Research using the item-method has shown that TBF items are less likely to be retrieved than the TBR items (Baddeley et al., 2015; Johnson, 1994). As Basden and Basden (1996) found, participants have difficulty retrieving the TBF items and subsequently remember fewer TBF items, in comparison to TBR items. This implies that forgetting occurs within the time of encoding or very shortly after encoding, as participants are more likely to release any item associated with the TBF cue and use that time to encode TBR items. This is known as 'selective rehearsal' (Bjork, 1970; Bjork, 1972; Bjork & Geiselman, 1978). Both recall and recognition tests support this notion (Basden, Basden & Gargano, 1993; MacLeod, 1999). However, research has identified other factors that could also play an important role in the forgetting of the TBF items, such as attentional/ executive control mechanisms (Weiner, 1968). Item

inhibition would render items inaccessible in memory, and only under certain circumstances can they be rendered free from the inhibition (Geiselman, Bjork & Fishman et al.,1983). Zacks et al. (1996) argued that the TBF instruction takes attention away from the stimulus in such a way that it acts as a form of inhibition for memory.

1.2.5. Cue effect on memories and suppression

1.2.5.1. Suppression & Intentional Suppression

Within the DF literature, research has suggested that both TBR and TBF items are rehearsed separately within memory (Bjork, 1972). Evidence has been derived from studies using Event-Related Potentials (ERPs) and Functional Magnetic Resonance Imaging (fMRI), both of which have found corresponding neuronal structures, such as the frontal lobes, that activate based on cue type (Wylie et al., 2008). Researchers have argued that selective rehearsal is a core mechanism in understanding the handling of these cues, where, prior to receiving any instruction, all items are rehearsed to maintain a representation of that item (Woodward et al., 1973). Once the cue has been shown, the 'remember' items are usually further rehearsed whilst the rehearsal of the 'forget' items is minimised (Basden et al.,1993; Bjork & Woodward, 1973; Wylie et al., 2008).

Yet processing of both cues has also been heavily linked to mechanisms such as suppression. Suppression allows an individual to consciously avoid thinking about a specific thought (Wegner et al., 1987). This is seen in the TNT paradigm and Anderson and Green's (2001) results (see Figure 1.3). Evidence from the TNT paradigm highlights the role intentional suppression plays in making memories inaccessible (Benoit & Anderson, 2012; Kim & Yi, 2013; Racsmány et al., 2012).

Indeed, the cue/instruction may determine whether the memory is triggered into consciousness or not. Yet occasionally attempts to suppress an unwanted memory may have adverse effects that lead to ironic control processes (Wegner, 1994). These ironic processes mean that the memory breaks into awareness. Ironic control processes can be overcome by thinking about something totally irrelevant (Hertel & Calcaterra, 2005), which can allow the event to be forgotten. This mechanism is used to deliberately provide (retroactive) interference in order to disable the unwanted memory (Anderson & Neely, 1996).

However, other research has identified different processes, such as attentional or executive control mechanisms. In fact, ERP studies, such as Hsieh et al. (1999), found that the ERPs were more distinct in regard to the TBR than TBF cue, which would mean that the TBR associated items would be easier to remember. Hsieh et al. (1999) even argued that the cues serve as a medium that triggers attentional resources for items within short-term memory, and this notion was gathered from ERP support, as the TBR items were deemed to be more positive in ERP effects than TBF items. In conjunction with this was the finding of the P3b wave, which is associated with attention, memory encoding and evaluation of stimuli (Kok, 2007; Polich, 2007). TBR items produce a larger P3b wave (Hsieh et al., 2009; Paz- Caballero & Meno, 1999), suggesting that TBR items are more likely to receive attention than the TBF items.

Further evidence for suppression comes from the theory of inhibition, including Weiner's (1968) favoured 'retrieval inhibition'. According to this account, the TBF instruction takes attention away from the stimulus and leads to the item being inhibited (Zacks & Hasher, 1994; Zacks et al.,1996). Results have shown that the TBF items are encoded but become inhibited and only under certain circumstances

are rendered free from that inhibition (Geiselman et al., 1983). Thus, it can be argued that inhibition of TBF items leads to less accessibility at the time of retrieval, making the TBR items easier to remember (Ullsperger et al., 2000).

To further explore this concept, Fawcett and Taylor's (2008) study can be taken as an example, where they found that participants were slower in performing a secondary task when there was a TBF cue before it. This suggests that greater effort may be needed in order to abide by the TBF cue. Fawcett and Taylor's (2008) results are also a further potential example of the 'active forgetting' processing (Baddeley et al., 2015).

1.2.6. Assessing the DF paradigm and effect

The DF effect is a robust cognitive finding that has been consistently reported for over 30 years (see Golding & Gottlob, 2005; Golding & Long, 1998; MacLeod, 1998). Furthermore, it has been shown that DF is not the result of demand characteristics (where participants deliberately withhold the TBF information during retrieval; Bjork & Woodward, 1973; MacLeod, 1999). In some studies, participants have been given further incentives to boost TBF recall, but this had little effect (MacLeod, 1999). Additionally, the DF effect is evident in both the item-method and list method for both recognition and recall tasks. This was demonstrated by MacLeod (1999), who gave participants an initial recall test of both TBR and TBF items. Next, a monetary incentive was given to encourage additional recall of any remaining TBF items. After this, a recognition test was implemented for participants to indicate the cue associated with each word. MacLeod (1999) found the DF effect to be consistent even with interventions such as incentives, which eliminated any demand characteristics concerns.

In another relevant study, Geiselman et al. (1983) asked participants to judge whether words had been associated with TBR or TBF instructions. Participants were not able to categorise the TBF words whereas they had no problems in doing so with the TBR words. Geiselman et al. (1983) were thus able to suggest that the retrieval routes for the TBF words were disrupted. Once again, this supports the notion that DF is a robust effect.

Lastly, other demand characteristics and their role within DF have also been refuted by Aguirre et al. (2020). They looked at selective DF and tested whether demand characteristics influenced their results, especially in regard to participants withholding the TBF items to comply with the study's goals. They also assessed the role of output interference from the TBR items, where there is a recall impairment for some items due to previously learnt items from the same set (Aguirre et al., 2020; Malmberg et al., 2014). When considering the DF paradigm, participants may recall the TBR items first which would interfere with later recall of the TBF items. The list method was used and participants had to recall the TBF items first, which would eliminate the element of output interference. They found that both experiments were not influenced by output interference, as there was no increase in the recall of TBF items in comparison to the TBR items. Aguirre et al. (2020) argued that despite TBF items being recalled first, the TBF items were less likely to be recalled than TBR items, even if there was a monetary reward involved. This would suggest that demand characteristics and output interference do not influence DF and participants do not withhold TBF items at any cost. Rather, the items are susceptible to being intentionally forgotten.

1.3. Emotional memories

1.3.1. Emotional bias

As shown in the preceding section, the DF effect is robust and suggests that stimuli can indeed be intentionally forgotten. However, an unresolved question concerns whether all types of stimuli can be intentionally forgotten or whether some stimuli are harder to forget than others. In particular, emotional memories may be resistant to DF.

In support of this idea, research has found emotionally arousing experiences to be remembered and recalled better than neutral events (Barnacle et al., 2016; Barnier et al., 2007; Buchanan, 2007; Cahill & McGaugh, 1998; Challis & Kran, 1988; Cheng et al., 2012; Doerksen & Shimamura, 2001; Joorman et al., 2005; Kranske & Kotz, 2007; McGaugh, 2003; Payne & Corrigan, 2005; Power et al., 2000; Talmi & McGarry, 2012; Talmi & Moscovitch, 2004; Zimmerman & Kelley, 2010). This may be due to emotional material being more 'attention grabbing' (Blaney, 1986) than neutral material (Blaney, 1986; Bradley et al., 2003; Liu et al., 2008), improving encoding of emotional material (Cahill & McGaugh, 1998) and enhancing consolidation and retrieval (Hamann, 2001). As such, representations for emotional memories may be stronger than the representation of neutral memories, increasing their accessibility (Norman et al., 2004). While research is divided about the role of attention, evidence still supports the idea that emotional material is processed quickly (Kousta et al., 2009). In summary, this emotional enhancement may strongly influence whether items can be successfully removed from memory (Taylor, 2005).

Though there is a consensus that emotional events are remembered better within both intentional and incidental forgetting, there is research that raises another

issue entirely. This concerns memory for different types of emotional stimuli and there is uncertainty about retention rates of positive and negative information.

Firstly, positively valenced events or stimuli may potentially be easier to recall than negative events. This is supported by the 'positivity bias' (Baddeley et al., 2015) that was documented by Waldfogel (1948), who looked at positive life events and their accessibility in memory. He found participants were able to remember 50 percent of the ‘positive memories’ as compared to 30 percent of ‘negative memories’ and 20 percent of ‘neutral memories’. This suggests that positive memories may be easier to recall (Bernsten, 1996).

The positivity bias may be linked to survival, based on approaching something that is beneficial and avoiding something that is not (Damasio, 2001). Emotional arousal may also be important, as arousal can lead to the release of certain endorphins and stress hormones such as epinephrine and cortisol (McGaugh, 2013). This can then lead to positive stimuli being more memorable than negative or neutral information. In fact, it has been suggested that the continuous release of epinephrine results in a more enjoyable experience, contributing in that experience being better remembered.

Further support for this possibility came from Cahill and Alkire (2003), who had healthy participants view 21 slides that were divided according to valence (negative, neutral and positive). Afterwards, they were given a mixture of either epinephrine or saline. One week later, participants were called back for an unexpected recall test and exposure to post-learning epinephrine enhanced consolidation for long term memory. Their results showed an advantage of memory consolidation for the emotional slides.

However, within their study Cahill and Akire (2003) showed that an increase in epinephrine led to better recall for *both* positive and negative stimuli. Additionally, Kensinger and Corkin (2003) found recognition to be higher for negative words, highlighting a 'negative bias' (Cacioppo & Gardner, 1999). The term ‘negative bias’ refers to the advantage of negative stimuli over positive or neutral stimuli in memory. This may be due to the attentional resources allocated to negative material (Pratto & John, 1991), which give this type of information a processing advantage. The preference in recalling negative stimuli may also result from increased physiological responses to negative events (Taylor, 1991).

It has also been argued that negative information may not be a recipient for prioritised attention, but rather it holds attention for longer (Fox et al., 2001). This prolonged hold of attention slows down other ongoing activity so that threats and potential dangers can be identified (Algom et al., 2004). Support for this idea comes from the 'Stroop' task where the name of the colour the word is printed in is affected by valence, and results found undesirable traits (negative stimuli) to interfere more with the Stroop task (Pratto & John, 1991)**.**

The strong impact that both positive and negative events and stimuli have on memory poses an important question: Are both valences less susceptible to intentional forgetting than neutral information?

1.3.1.1 Intentional forgetting and emotional bias in the TNT task

This emotional bias outlined above may influence intentional forgetting and many researchers have examined emotional content within the TNT paradigm (Hertel & Gerstle, 2003; Lambert et al., 2010; Wessel et al., 2005). One example comes from Depue et al. (2006), who paired emotionally valenced words and images (images depicted neutral, negative and positive facial expressions). For the first

experiment, a total of 80 face-word pairs were used in the three phases: training, TNT and test. After the training phase, the TNT phase involved viewing 32 stimulus pairs (equally divided between the 'think' condition and 'no-think' condition). Trials were initiated by a fixation cross and its colour indicated the necessary response (think vs. no-think). Participants were told to either think of the words that matched the associated face (for the think condition) or not to think about it (for the no-think condition). During the test phase, participants were shown the faces again and were told to write down the words that were associated with them. Results showed that more of the neutral words were remembered than the negative words. This could be suggesting that overall control within memory for negative items is quite effective. However, this could also have been due to the higher number of neutral cycles that were shown within the training phase.

The second experiment was then used to assess cognitive control mechanisms for negative and neutral pictures. Depue et al. (2006) replicated the first experiment (but this time with pictures rather than words) and found similar results. Yet it is also important to note that Depue et al. (2006) only found this emotional bias for the think condition, with negative information having increased recall, but for the no-think condition there was decreased recall for the negative stimuli in comparison to the neutral. Based on these findings, cognitive control mechanisms deployed for emotionally salient material can go two ways. They can work to either enhance information or reduce it based on the information received within training (Depue et al., 2006).

1.3.1.2. Intentional forgetting and emotional bias in the DF task

When considering the same issue within the DF paradigm, studies utilising emotional stimuli have yielded mixed results. Some studies have found a smaller DF

effect for emotional material and a larger DF effect for neutral material. This was reported by Yang et al. (2012), who used 560 complex images within a recognition task. The images included an equal mixture of negative and neutral items, and these were further divided amongst two stimulus sets (one set served as a distractor and the other as study items). Yang et al. (2012) found that there were higher hits for the emotionally negative images compared to the neutral images, which suggests that it is harder to intentionally forget something that is negative in nature. Interestingly, Yang et al. (2012) also examined ERPs and compared them within intentional and unintentional forgetting. During negative image viewing, there were enhanced late parietal positive potentials (LPPs), suggesting that the negative stimuli were a recipient of enhanced attention in comparison to the neutral images. This may have been responsible for the enhanced recognition of the negative images. However, regardless of the impact the negative images had, the DF effect was still evident, as both valences were susceptible to DF.

This DF effect for negative stimuli was also found by Wessel and Merckelbach (2006) who, unlike Yang et al. (2012), used the list method of DF. Yet DF may still be reduced for negative information and Hauswald et al. (2010) found a larger DF effect for neutral images in comparison to negative images and higher LPPs for negative images. This suggests that the mind does take extra heed of negative stimuli, making it harder to actively suppress those items from memory. However, unlike Hauswald et al. (2010), Yang et al. (2012) do not claim that negative stimuli are exempted from DF.

Studies such as Yang et al. (2012) and Hauswald et al. (2010) have found neutral stimuli to be forgotten more readily in comparison to stimuli that are emotional (Hamann, 2001; Barnier et al., 2007; Wylie et al., 2008; Nowicka et al.,

2010). However, according to Yang et al. (2012) and Wessel and Merckelbach (2006), both the negative and neutral valences are susceptible to being intentionally forgotten. Conversely, Hauswald et al. (2010) argue that negative material is not impacted by DF. These conflicting findings have been demonstrated elsewhere (see Brandt et al., 2013) and other research has found no difference in DF according to valence (Gallant & Yang, 2014; Patrick et al., 2015; Taylor et al., 2018; Quinlan et al., 2010).

The issue becomes more complex when introducing the positive valence. An example comes from Bailey and Chapman (2012), who used 480 positive, negative and neutral words and found traditional DF, alongside better recall for emotionally salient words. However, negative words were more likely to be correctly recognised than positive words, though positive stimuli may still have a strong impact on DF. Due to its ability to activate associative networks (Bolte et al., 2003; Storbeck & Clore, 2005), positive information is more likely to abolish DF effects. This was supported by Bauml and Kuhbander (2009) who used the list-method of DF and varied the valence of the list. They also presented images to influence the moods of the participants. Bauml and Kuhbander (2009) found that positive moods can lead to the 'forgetting' list being activated and un-doing the forgetting cue instruction. This suggests that positive stimuli and mood may be important moderators in determining whether DF takes place, which is somewhat congruent with Hauswald et al.'s (2010) findings for negative stimuli.

In summary, emotionally salient material has complex effects on memory and its effects on DF are unclear. When exploring DF for emotional memory, there seems to be a gap within understanding due to the contradictory results reported. From an estimated 28 studies that look only at the item-method of DF, 11 focus on

valence and DF and only five of these focussed on all three type of valences. Nevertheless, in the 11 studies that examined valence, five found that negative stimuli experience lower DF in comparison to neutral stimuli, one found that neutral stimuli experience lower DF than negative stimuli, another found more DF for neutral than positive material, whilst two studies showed that positive stimuli underwent less DF than other valences. Two studies even reported less DF for neutral stimuli (see Appendix 14 for an in-depth overview). Looking at the existing literature, there are contradictory results, which may be due to a variety of factors, including the retrieval methods (a majority are recognition studies). DF for emotional material may also be influenced by the population tested (clinical vs. non clinical), as well as the stimuli, as some studies utilise nouns, phrases, other languages etc., and others use images. The present project aimed to examine the factors that may influence the DF effect for the three valence types.

1.3.1.3. Assessing valence differences within DF

A further challenge in understanding how DF is affected by valence depends on the manner in which DF is operationalized. Indeed, the measurement of DF has been approached in multiple ways (see Chapters 2-7). Though there is no 'correct' way to assess the DF effect, the present project uses several measures to allow us to gauge DF from different angles. For example, within an ANOVA, the interaction between cue and valence can be examined. A significant interaction could indicate differences in DF according to valence, though it is also possible that such an interaction is driven by valence differences *within* a cue and not *between* the cues. Thus, a strong interaction might be found, yet robust DF for each valence may also be identified.

To avoid valence differences within a cue, a DF score can be computed, which directly identifies how much DF has happened. This is normally calculated by subtracting the TBF scores from the TBR scores, where a positive score would then indicate a DF effect, and a negative score would indicate a reversed DF effect. In fact, the DF score has been used by other researchers wishing to quantify how much DF has happened within each valence dimension or amongst valence and other factors (Kuehl et al., 2017; Patrick & Christensen, 2003; Soriano, Jiménez & Bajo, 2009). However, the DF score ignores differences between TBR and TBF performance, as it looks at DF as a single dimension rather than an interaction. As such, the DF score may be influenced by TBR performance, where higher TBR scores within one valence would suggest that a certain valence experiences more DF (see Chapters 2-6).

An alternative method, termed the Cowan statistic (Cowan 2001), can correct this by more effectively considering differences within the TBR cue according to valence. This helps to quantify the maximum decline within an individuals' performance. The Cowan score is calculated by dividing the DF score (TBR-TBF) by the TBR score, which gives a proportional measure of DF. This allows us to identify and explore how much DF has happened in relation to the maximum DF that could happen. Yet, even with this statistic, variability within this measure can be high, due to the possibility of negative scores (i.e. TBF recall can sometimes exceed TBR recall).

By including all three approaches here, this thesis aimed to overcome any weaknesses within individual measures of DF. This makes the current approach more thorough in understanding valence differences within DF.

1.4. The Present Research

1.4.1. Rationale of the current project

Existing literature has shown that intentional forgetting does occur and there are plausible explanations of this phenomenon. However, the conflicting nature of past research within DF and emotional memory is important to acknowledge. There are numerous DF studies but only a handful have explored DF for all three valences, and there are contradictory findings. This project aimed to explore DF for emotional and neutral information, whilst also considering other factors (e.g. categorised stimuli, individual differences, decay and so on) that influence DF, to see how they influence the nature of DF for all three valences. Indeed, this project explores factors that could plausibly affect DF for valence, but which have often been neglected in prior studies and their contribution may have been missed. The intention was to determine whether the above mentioned factors may have influenced the contradictory results and discrepancies that have been identified in previous DF research. Additionally, most of these variables have not been extensively assessed before, in relation to valence effects on DF.

This thesis also used words as the stimuli, but as per previous literature and fluctuating results, different properties of words (nouns, adjectives, categories) were examined, to see how they relate to DF.

Looking at the research discussed above and the majority of the forgetting literature, intentional forgetting is a day-to-day occurrence, but valence is an intriguing factor and most research highlights its importance (Anderson et al., 2004; Blaney, 1986; Barnier et al., 2007; Depue et al., 2006; Gray et al., 2002; Hamann, 2001; Kensinger & Corkin, 2004; McGaugh, 2003; Nowicka et al., 2010; Sharot et al., 2007; Wylie et al., 2008). Support for this comes from neurobiological processes

(Cahill & McGaugh, 1998; Hamann, 2001; LaBar & Cabeza, 2006; Sharot et al., 2004). Yet the controversial nature of which 'emotion' or 'valence' plays an integral part in DF is controversial as evidence is contradictory (Baddeley et al., 2015; Bernsten, 1996; Cacioppo & Gardner,1999; Fox et al., 2001; Hauswald et al.,2010; Pratto & John, 1991; Waldfogel, 1948). Some studies suggest greater DF for emotional memory whilst other studies show reduced DF, so there is a prominent gap in the understanding of whether emotionally valenced memories can be intentionally forgotten, and the variables that may affect this. The existing literature on valence and DF questions how easy it is to suppress emotional memories and whether emotional DF truly differs from neutral DF.

In fact, determining the extent to which a specific valence type can be intentionally forgotten is challenging due to mixed findings. There are many other factors that may have influenced the results, but most prior studies used recognition tasks (See Appendix 14). An example is Zwissler et al. (2011), who found higher hits for neutral images compared to positive images, whilst in another study there were higher hits for emotional stimuli in comparison to neutral stimuli (Marchewka et al., 2016). Recognition tasks can also be affected by other memory processes, such as familiarity. Thus, exploring how valence affects DF within recall tasks is especially important.

Adding to the complexity of the field are studies that deal with different sets of participants, such as younger participants aged 8 - 12, where a standard DF effect was found for both neutral and negative images (Augusti & Melinder, 2012). Even studies that use another language (such as 480 negative and neutral Chinese characters) found neutral stimuli to be less prone to DF than negative stimuli (Liu et al., 2017). The inconsistency throughout these results is prominent in the DF

literature, even though studies like the above all use the item-method. This highlights the complexity of emotional valence within memories when it comes to DF.

Additionally, looking at both procedures within the DF paradigm, they serve different purposes in recognising potential underlying mechanisms. As the item-method is known to focus on rehearsal and the list-method shows a smaller effect within recall tasks (MacLeod, 1999), a decision was made to use the item-method of DF. Within the item-method, participants use maintenance rehearsal to hold the stimuli in working memory (WM) until the presentation of that instruction and based on the instruction they either rehearse or actively try and remove the stimuli. Thus, the item-method taps into encoding mechanisms and memory representations (Hauswald & Kissler, 2008) whereas the list-method focuses on retrieval. This makes the item-method versatile and a more convenient way of testing DF in relevance to other factors within this thesis.

1.4.2. Summary of aims and key research questions

The experiments within this thesis were designed to explore the concept of DF in relation to valence. This was done to provide a better picture of what constitutes successful intentional forgetting and whether other external factors such as time and stimulus characteristics can affect DF for each valence. In the next two chapters, the general mechanisms of DF will be explored alongside the role of valence and time. Chapter 4 explores sex differences and arousal amongst both free and cued recall tasks, whilst Chapter 5 focusses on individual differences such as mood and emotionality, alongside the impact of word concreteness. The last experiment further explores stimulus categories and the role they play in DF. Each experiment used DF to measure the extent of intentional forgetting.

Chapter 2.

Experiment 1: Time and valence effects in DF

2.1. Abstract

The present study aimed to examine intentional forgetting by using the item-method of DF and emotional and neutral stimuli. Through this study, time and possible decay mechanisms were also explored to see if they would impact DF, especially for different valences. Participants viewed a total of 96 words (positive, neutral or negative) followed by a cue instructing participants to remember or forget each item. A short delay (50 ms) or long delay (10 s) then followed each cue. At the end of the presentation, participants were asked to recall all words regardless of cue. A traditional DF effect was found, where the 'remember' items were recalled better than the 'forget' items. Emotional items were also remembered better than neutral items, though the TBR positive words were more likely to be remembered than the TBR negative words. In fact, the negative items were forgotten rapidly over longer delays, suggesting that time played a role within memory. However, it did not affect the DF effect itself.

2.2. Introduction

2.2.1. The active forgetting account and DF

An active forgetting process, as outlined in Chapter 1, can be further understood in the context of active decay. Active decay is the theory that argues for the weakening of memory traces over time in an adaptive manner, which is a relatively new concept

(Hardt et al., 2013). Hardt et al. (2013) have suggested that unwanted memories may be removed actively based on how relevant or recent they are.

This active decay process has been tested using multiple stimuli, including verbal and non-verbal stimuli (McKeown & Mercer, 2012). In fact, Ricker and Cowan (2010) found that time played a significant role in remembering visual stimuli, with recognition accuracy being higher after 1.5 s delays rather than 3 s or 6 s delays. This suggests that time plays an important role within unintentional forgetting, however it is a matter of debate as to whether this effect can also be applied within intentional forgetting. DF studies such as Albeit et al. (1994) found that increasing processing time of both cues affected recollection for TBR items but not TBF items. This would indicate that time is an important factor within DF, but whether there is more rehearsal of the TBR items is also something that needs to be investigated.

Unfortunately, many DF studies have introduced time as an uncontrolled variable which may have affected the results. For example, Nowicka et al. (2010) inserted different time delays after each cue, but they did not take these delays in to account or formally test their effects. Nowicka et al. (2010) implemented their study into two phases. The first phase had images divided amongst neutral and negative valences, and these images were further divided amongst cue (TBR and TBF). A variable post-cue delay was also inserted (6, 6.5 or 7 seconds). Additional studies have also included a varied delay after stimuli, such as Yang et al. (2016), who inserted a 1 s delay after the stimuli and then a post cue delay of either 1 s, 1.5 s, 2 s, 2.5 s, or 3 s. However, the effects of the delays within this study were not assessed in the analysis.

Delays have been inserted in various DF studies including Wylie, Foxe and Taylor (2008), who used a pre-cue delay; Lee and Lee (2001), who utilized post-cue

delays and Abel and Bäuml (2017), who utilized a 60 second delay within their list method study. When comparing these studies, delay has only been manipulated within a few studies, suggesting that within the DF field, post-cue delay is a variable that is not used consistently or thoroughly and therefore needs to be tested.

2.2.2 Decay, Valence and DF

In regard to the DF studies above that have varied post-cue delay, a major aspect that is always manipulated is the type of stimuli and for some studies, the main area of manipulation is valence. As discussed in Chapter 1, there have been contradictory findings in regard to valence and DF, where some studies have identified higher DF for neutral events against emotional events (Yang et al. 2012; Hamann, 2001), whereas other research has indicated different findings (Hauswald et al., 2010) and even no differences in DF for valence (Tolin et al., 2002). This would suggest that there may be other, unexplored factors impacting DF for valence.

Other studies have also used different post-cue delays, such as Nowicka et al. (2010). However, while the post-cue delays were varied, the effects were not formally tested, though a DF effect was uncovered for both valences. There were also higher recognition rates for the TBF emotionally valenced images. Thus, from Nowicka et al. (2010) it can be argued that though both types of valence are susceptible to DF, emotional memories are much harder to forget in comparison to neutral memories. This was also reported by Yang, Lee and Anderson (2016), who also manipulated valence and inserted post-cue delays. Their results indicated an emotional bias, with neutral words showing higher DF than negative words. However, as with Nowicka et al. (2010), Yang et al.'s (2016) study also focusses on just two valences (negative and neutral). Studies such as these have neglected the

positive valence (See chapter 1). It is therefore necessary to investigate DF for each valence and following different post-cue delays, to determine whether an active decay process influences DF.

2.2.3. The present study

Considering the above research and contradictory findings on DF and for emotionally valenced material (negative, neutral and positive), it is imperative to further investigate the DF and valence effect. This study also aimed to assess whether a post-cue delay can affect DF and potentially explain why there have been contradictory findings in some earlier work.

This study used the item-method of DF and assessed the role of valence. It aimed to determine whether the length of the delay after the cue – short (50 ms) and long (10 s) – could also influence DF.

The following hypotheses were tested:

H_1) Participants will recall more words associated with the TBR cue than words associated with the TBF cue.

H_2) Participants will recall more emotionally valenced words than neutrally valenced words.

H_3) Participants will also recall more negatively valenced words in comparison to positively valenced words.

H_4) Participants will be more likely to recall words when there is a short delay in comparison to a longer delay.

H_5) Participants will be more likely to recall emotionally valenced TBF words than neutrally valenced TBF words.

H_6) Participants will be more likely to recall the emotionally valenced words when there is a longer delay in comparison to the neutrally valenced words.

2.3. Method

2.3.1. Participants

A G*Power analysis was conducted based on an undergraduate study that had similar variables to the present experiment.[1] Using G*Power, effect size was calculated based on the important cue and valence interaction. This indicated that a minimum sample size of 30 participants was required based on an alpha value of .05 and 80% power. However, to further increase power above the absolute minimum, the study was carried out on 50 undergraduate Psychology students from the University of Wolverhampton (45 females and five males aged between 18 and 51 [*M* = 23.16, *SD* = 6.69]). Participants were volunteers recruited via SONA (a university portal used for recruitment of undergraduates which offers credits in return for completing studies). Lecture invitations and emails were also used to invite participants.

2.3.2. Materials

Participants were provided with a total of five sheets and the initial paperwork consisted of an information sheet, informed consent form and demographics questionnaire. The information sheet offered important information about the purpose of the study, associated risks and benefits, and the ethical considerations

[1] This previous study was conducted in 2013 as part of an undergraduate dissertation. The study held similar elements, assessing DF, valence and time. However, stimuli were not as controlled and there may have been extraneous variables (e.g. word frequency).

that had been addressed (e.g. the use of emotional words). The consent form reiterated important aspects of the study and ensured full consent from participants. A demographics questionnaire asked about age and sex. A recall sheet was also used for participants to write down the recalled words. A debrief sheet was given to clarify the true intent of the experiment and to account for any deception within the study. Details and contact methods for counselling services were also printed on the debrief sheet.

For the actual experiment, a total of 96 words were used. These were adopted from the ANEW list (Bradley & Lang, 1999 [Appendix 3]) and were divided equally amongst the three valences: positive, neutral and negative (e.g. joy, air and fat). The word list was created to be equally divided among the three valences, to ensure equal distinctiveness (Talmi & McGarry, 2012), as distinctiveness can be changed by modifying the combination of the stimuli and mean certain stimuli are remembered better than others (Talmi & McGarry, 2012).

The words were also further divided amongst the time delay (50 ms or 10 s), word length and cue (TBR and TBF). Each list contained four words and was carefully created so that all lists were similar. The mean length of the words across lists was 6.50.

Words were shown to participants on a computer screen (19" HANNS.G HP191) using 'SuperLab' 5 software (Cedrus Corporation). Lastly, all words and cues were shown in a black Arial font at size 72.

2.3.3. Design

The study used a repeated measures design including three independent variables (IVs). The first IV was the emotionality of words, which had three levels

(positive, negative and neutral). The second IV was the two cues (TBR and TBF) and the last IV was the time delay inserted after cues, which also had two levels (50 ms and 10 s). The dependent variable (DV) was the number of words that were correctly recalled. Ethical approval was granted by the Ethics committee of the University of Wolverhampton (Appendix 15).

2.3.4. Procedure

Each participant sat in front of a desktop computer that was situated in a designated room. The participants were given instructions and basic information about the experiment. They were then given an information sheet to read and then handed an informed consent page. They had to read this sheet and give their consent, which indicated that they fully understood the terms of the study. After this, participants were given a demographics questionnaire, which they filled in. Once these sheets were completed, they were handed to the researcher for secure storage. At this point the researcher verbally presented the instructions to the participant.

Next, all 96 words were presented on the screen individually. The words were presented in a random order and displayed for 1.5 s. After the presentation of each word, a cue (either TBR or TBF) was also shown for 1.5 s. A designated time delay (50 ms or 10 s) then followed the cue. The cue prompted the individual to either remember or forget the word and the time delay could help further consolidate the word or remove the unwanted word from memory. After the presentation of the words, participants were asked to recall all the words regardless of the cues that were associated with them. They were given five minutes to do this and had a recall sheet to manually write down the words. After the five minutes elapsed, the recall

sheet was collected by the researcher and the participant was handed a debrief sheet to explain the nature of the study.

2.4. Results

The data were added into a spreadsheet to calculate the words recalled. A column was allocated to each participant and words were marked based on whether they were successfully recalled. A point of '1' was given for each correct recalled word. Recalled words were only considered correct if they were spelt correctly and did not vary in any way from the original word. Proportions were then calculated for the number of words remembered according to cue (TBR and TBF), valence (positive, neutral and negative) and time (50 ms and 10 s). After this point, the data were added into SPSS (V 20).

Table 2.1.

Mean (and SD) for proportion of correctly recalled words according to cue, delay and valence.

	Short Delay			Long Delay		
Cue	Positive	Neutral	Negative	Positive	Neutral	Negative
TBR	.32 (.14)	.18 (.14)	.30 (.21)	.29 (.17)	.21 (.16)	.20 (.15)
TBF	.11 (.11)	.04 (.07)	.10 (.10)	.07 (.08)	.05 (.08)	.06 (.08)

When examining the proportion of words correctly recalled, there was better recall for TBR words in both delays, suggesting a traditional DF effect. When assessing the short delay (see Table 2.1), positive words were remembered more on

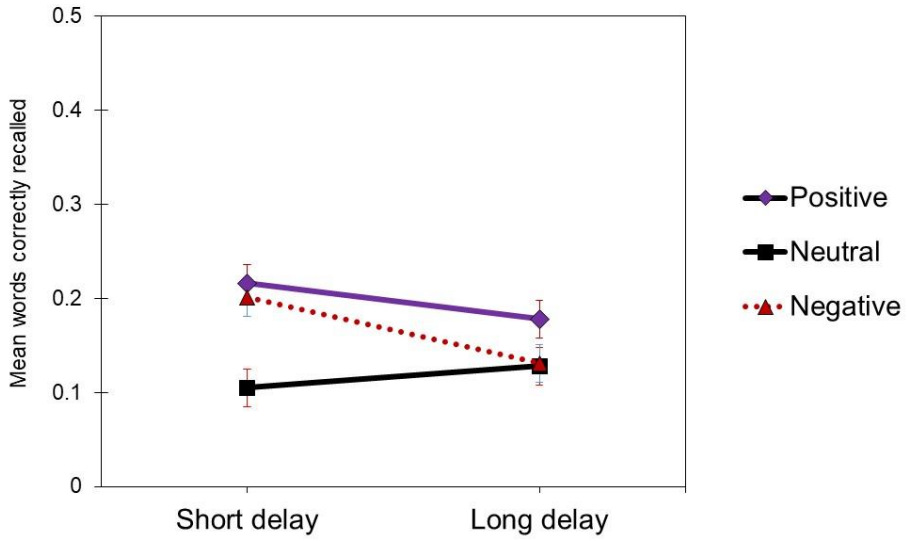
average when a TBR cue was present (*M* = .32, *SD* = .14), followed by the negative words (*M* = .30, *SD* = .21) and then the neutral words (*M* = .18, *SD* = .14). For the long delay, positive words were remembered more on average when a TBR cue was present (*M* = .29, *SD* = .15), and this also applied to the negative words (*M* = .20, *SD* = .17). However, the neutral words were recalled more than the negative words following a TBR cue (*M* = .21, *SD* = .16), though this did not apply to the TBF associated words (*M* = .05, *SD* = .08).

A repeated measures ANOVA was then conducted to test how the three IVs affected correct recall. The factors were valence (neutral, negative and positive), delay (short and long) and cue (TBR and TBF). Where the sphericity assumption was not met, the Greenhouse-Geisser correction was applied. The results showed a significant effect for cue (F [1, 49] = 134.58, $p < .001$, $\eta_p^2 = .73$), as the TBR cue led to better recall than the TBF cue. Delay was also significant (F[1, 49] = 13.69, $p < .005$, $\eta_p^2 = .22$), which indicated that fewer words were remembered following a long than short delay. Additionally, a significant effect was found for valence (F[2, 98] = 9.77, $p < .005$, $\eta_p^2 = .17$), which indicated that the valence of the word had an impact on recall. To confirm this, Šidák adjusted post-hoc tests were conducted as they are less conservative (less likely to miss an effect) than the Bonferroni post-hoc test. The Šidák correction is also considered to have more power for comparing larger test sets (Kim, 2015) and gives a more accurate value, whilst the Bonferroni test is known to give approximations at the time of correcting (Abdi, 2010).

The Šidák corrected *t*-tests showed significant differences, with higher recall of positive words (*M* = .20) in comparison to neutral (*M* = .12, $p < .001$) and negative (*M* = .17, $p = .034$) words. The analysis also found a significant difference for the recall of neutral and negative words ($p < .001$).

Figure 2.1

Mean proportion of words correctly recalled according to valence and post-cue delay. Error bars show 95% CIs calculated according to Jarmasz and Hollands (2009).



In terms of the interactions, the delay and valence interaction was significant (F[2, 98] = 7.69, p = .001, η_p^2 = .14), indicating that these two variables influence each other at recall (see Figure 2.1). The interaction graph above shows that positive words were remembered more at shorter delays, followed by negative and then neutral words. Yet the difference between positive and negative words seems to be minimal at the shorter delay. At longer delays, negative word recall declined more rapidly than the positive word recall. Interestingly, there also seems to be an incline of recall from the short to the long delay for neutral words.

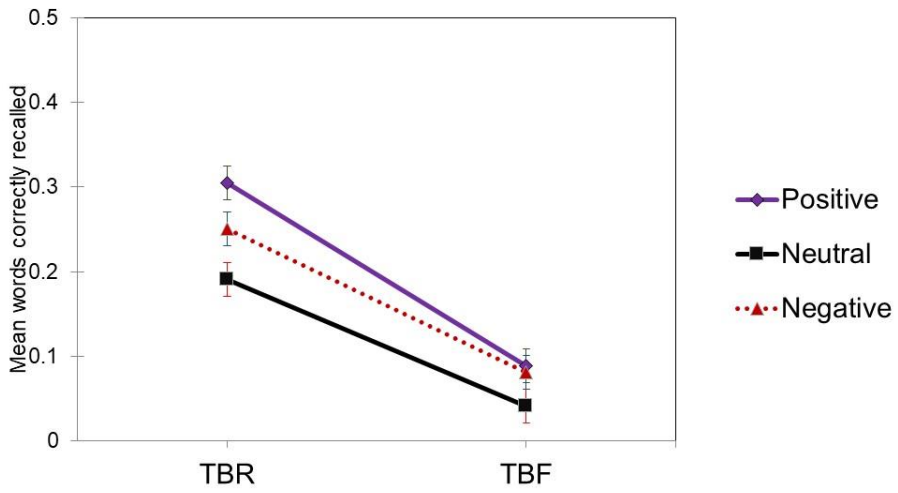
To explore this interaction, paired-sample t-tests were conducted. The p-value was again adjusted using the Holm- Šidák correction. There was a significant difference in the type of words that were remembered for the short delay, as the

positive words (*M* = .22, *SD* = .12) were more likely to be remembered than the neutral words (*M* = .11, *SD* = .09; *t*[49] = 5.96, *p* < .001, *r* = .64). The same effect was shown for the recall of the negative words (*M* = .20, *SD* = .12) compared to the neutral words (*t*[49]= 6.02, *p* < .001, *r* = .66). However, there was a non-significant difference between positive and negative word recall (*t*[49] = .78, *p* = .442, *r* = .10).

In regards to the long delay, there was a significant difference in the amount of positive words recalled (*M* = .18, *SD* = .08) in comparison to the neutral words (*M* = .13, *SD* = .08, *t*[49] = 3.50, *p* = .004, *r* =.44). A similar effect was shown when comparing positive and negative words (*M* = .13, *SD* = .09), with significantly higher recall for the positive than the negative words (*t*[49] = 3.38, *p* = .004, *r* =.44). However, when the comparison examined neutral words and the negative words, the effect was non-significant (*t*[49] = .315, *p* = .754, *r* = .00).

Figure 2.2.

Mean proportion of words correctly recalled according to valence and cue. Error bars show 95% CIs calculated according to Jarmasz and Hollands (2009).



The cue by valence interaction was also significant (F [2, 98] = 4.86, p < .005, η_p^2 = .09) - see Figure 2.2. As shown in Figure 2.2, fewer TBF than TBR words were recalled for all three valences. However, positive TBR words were recalled better than negative and neutral words. For the TBF cue, the recall of negative words was similar to positive word recall.

Once again, paired-sample t-tests were conducted to explore the interaction and the p value was adjusted using the Holm- Šidák correction. For the TBR cue, the negative words (M = .25, SD = .17) were remembered more than neutral words (M = .19, SD = .11; t[49] = 3.58, p < .005, r = 0.46). However, positive words (M = .31, SD = .14) were remembered more than the negative words (t[49] = 2.86, p < .001, r = 0.37) and the neutral words, (t[49] = 6.96, p < .001, r = 0.70). In terms of the TBR cue, there was a positivity bias.

For the TBF cue, more negative words (M = .08, SD = .07) were remembered than neutral words (M = .04, SD = .05), t[49] = 3.39, p < .005, r = 0.44). In terms of the positive words (M = .09, SD = .08) and the negative words, the effect was non-significant (t[49] = -.56, p = .579; r = .00). However, there was better recall for positive words in comparison to the neutral words (t[49] = 4.03, p < .001, r = 0.50). This suggests a similar trend that coincides with the TBR cue.

The ANOVA also indicated that there was a non-significant interaction between delay and cue (F [1, 49] = .35, p= .555, η_p^2 = .01) and between all three variables: cue, valence and delay (F [2, 98] = 2.13, p= .124, η_p^2 = .04).

Next, a DF score was computed by subtracting mean TBF from mean TBR for each valence, which quantified the amount of information lost following a TBF instruction. This allowed a better way of quantifying the decline from TBR to TBF without incorporating differences within the cues. A one-way repeated measures

ANOVA was conducted on the DF score and revealed a significant effect (F[2, 48] = 4.86, p = .01, η_p^2 = .09). A follow up Šidák post-hoc test revealed higher DF for positive (M = .22) than neutral (M = .15, p = .004) words. Negative words (M = .17) did not differ from the other stimuli.

However, the DF score does not take into account the valence differences within the TBR condition, which may lead to apparent big differences within DF. To combat this issue, Cowan et al.'s (2001) statistic was used to quantify cue-driven forgetting. TBR scores were used to indicate the maximum amount the participant could remember for a certain valence following a direct instruction to do so. Taking the DF score as one measure of forgetting and dividing it by the corresponding TBR score quantifies the amount of forgetting as a percentage. For example, if TBR and TBF recall scores were .3 and .15 respectively, the resulting DF value is .15 (.3 minus .15). Dividing the DF score (.15) by the TBR score (.3) results in a value of .5, leading to the assumption that approximately 50% of the information that could potentially be remembered was lost following a forget instruction. Calculating this statistic on the current data showed possible forgetting to be around 70% (positive: M = 69.13; negative: M = 68.58; neutral: M = 71.32). A one-way repeated measures ANOVA found no differences according to valence when based on this forgetting statistic (F[2, 41] = .09, p = .915, η_p^2= .002).

2.5. Discussion

2.5.1. DF findings

A traditional DF effect was found. The presentation of the TBR and TBF cues prompted the individuals to either forget the information or remember it successfully

at recall (Bjork, 1970; 1972; Bjork & Geiselman, 1978). Through this current study it can be argued that TBF items are impaired in comparison to TBR items (Baddeley et al., 2015; Basden & Basden, 1996; Johnson, 1994). As there was higher recall of TBR words and lower recall for TBF words, this suggests that individuals can indeed "sort out" items based on need or instruction at retrieval.

In relation to the above valence and cue interaction, Cowan and DF scores, having three related measures allows a more thorough understanding of DF (see Chapter 1). This is discussed further below.

2.5.2. DF and Valence

Emotionally valenced material was remembered better than neutrally valenced material, perhaps as the emotional words used within the study were more likely to have a stronger impact on participants (Christianson, 1992). Due to the distinct nature of these words (Hunt & Worthen, 2006; Tomlinson et al., 2009; Schmidt, 1991; Schmidt & Saari, 2007) and potentially the extra attention given to the emotional stimuli (Bradley et al., 2003; Liu et al., 2008; Talmi et al., 2007; Vuilleumier, 2005), the emotional words were retrieved better than neutral words (Dolan, 2002).

Yet valence did interact with the cue. The positive words were remembered more in comparison to the negative or neutral words, especially within the TBR cue. All valence types were remembered more for the 'TBR' cue than the 'TBF' cue, yet it was within the TBR cue that significant differences between positive and negative words were found. Within the TBF cue these differences were minimal even though positive and negative words were still more likely to be remembered than the neutral words.

Additionally, negative information was remembered better than neutral information (Cahill et al., 2001; Nowicka et al., 2011). This suggests an advantage for negative material, where attention may not be prioritised but rather it is harder to disengage (Tipples & Sharma, 2000; Most et al., 2005). Alternatively, negative stimuli may be generally harder to forget due to increased neural activity (Nowicka et al., 2011). Regardless, a general decrease in the recall of negative words was still found, which overall coincides with the traditional DF effect. This suggests that negatively valenced stimuli are still susceptible to being forgotten, which was also found by Nowicka et al. (2011), who argued that forgetting negative information may be difficult but not impossible. Just like the other two valences, negative information is susceptible to being forgotten when the TBF cue is present. Interestingly, the results also indicated that rather than a 'negative bias' (Hauswald et al., 2010; Moulds & Bryant, 2005; Taylor, 1991; Wylie et al., 2008; Fox et al., 2001) it is rather a 'positive bias' that is evident at times of recall (Bernsten, 1996; Waldfogel, 1948).

Results from this study suggest that positively valenced stimuli may have a greater impact on memory than negative stimuli, more specifically when participants are instructed to remember them. The higher recall of positive words in comparison to neutral and negative words could be due to the way attention was given to the positive words. Positively valenced information may actually expand this attention, making the individual remember broader details (Derryberry & Tucker, 1994). This could be tied to the higher recall of TBF negative than TBF neutral words too.

Yet these negative words were forgotten more rapidly over the time delays, whereas an increase in recall for the neutral words (though non-significant) and a steady, subtle decline for the positive words was found. Thus, unlike previous claims, negatively valenced stimuli may not in fact have priority over attention (Bradley et al.,

2003; Kousta et al., 2009; Pratto & John, 1991). Additionally, this result was intriguing and will be tested later to further assess the replicability of the quick decline for negative words.

2.5.3. DF, valence and decay

Emotional memory enhancement has been seen over delays (McGaugh, 2004) whereas within the current study there was no evidence for such an effect. The interaction between delay and valence showed that while negatively valenced information was remembered better than neutrally valenced information, it was "pushed out" of awareness at a quicker pace. This could ensure a healthy mindset (Anderson & Hanslmayr, 2014). The positive words, however, were shown to have a steady decline over the delay. This suggests that valence affects recall during longer delays, as negative stimuli seem to be forgotten more quickly in comparison to the neutral memories and positive memories. The type of valence impacts what can be retained for longer periods of time or not. In this case, both positive and negative words were remembered considerably more than neutral words at a short delay. Yet there was a traditional decline between the short delay and the long delay for both positive and negative words.

Words were also more likely to be remembered following a shorter than longer delay. This confirms that material is more likely to be remembered accurately within a shorter time of presenting that stimulus. This differs from the view of the delay having minimal impact on items (Woodward & Bjork, 1971). However, given the non-significant cue and delay interaction, DF was not impacted by the time variable. Within the study, participants were able to prioritise the TBR instructions regardless of whether there was a short delay or a long delay after the presentation

of each item. This could support a role for selective rehearsal, as well as suggesting that DF operates quickly as participants were able to consecutively rehearse TBR words, resulting in higher recall for them, as well as minimising rehearsal of TBF words (Basden et al., 1993; Bjork & Woodward, 1973; Woodward et al., 1973; Wylie et al., 2008). Arguably, it is this enhanced rehearsal that makes the TBR words easier to remember in comparison to the TBF words.

However, the extent to which decay may have had some influence cannot be fully understood due to the use of words. There is a possibility of TBF words being unconsciously rehearsed with the passage of time. Where some items may have gone through some form of decay, this may not be in the traditional sense of totally forgetting the TBF words but rather through the incorrect recalling of these TBF words (Talarico & Rubin, 2003). Thus, the results from this study may be more in line with the theory of inhibition, as participants were able to inhibit the TBF items almost instantly without needing the post-cue delay that was given. This may also explain why there was an absence of the delay and cue interaction. In summary, the results from this study are somewhat in line with those of Nowicka et al. (2010), who argue that the inserted post cue delays seem to have no impact on DF itself. However, it did seem to impact retention of emotionally valenced stimuli.

2.5.4. Future implications

In light of the above issues, it is necessary to highlight a few points that may alter the perspective on the results of this study and the DF paradigm more generally. Firstly, the words used for this study were high in valence, yet they were not matched on arousal, which is an important predictor of emotional stimuli recall (Buchanan et al., 2006; Hamann, 2001; Talmi & Moscovitch, 2004). In addition, the

large list of words may have led to a floor effect and impacted results, especially in the TBF condition. Thus, in order to truly identify the impact of emotional material within intentional forgetting, the stimuli should be matched on arousal. Lastly, list length should be shortened in order to see whether DF was not simply a floor effect.

2.5.5. Conclusions

In conclusion, individuals can intentionally forget both neutral and emotional stimuli when instructed to do so. The results from this study showed a strong and robust DF effect, where words were forgotten based on cue rather than valence. Additionally, this study found a strong positivity bias, particularly for the TBR cue, suggesting that upon instruction, individuals may remember positive words better than other valences. Post-cue delay affected recall, where a fast-acting removal of negative words was seen in comparison to the other two valences. However, the length of the post-cue delay did not interact with the DF effect, suggesting DF occurs very rapidly.

Chapter 3.

Experiment 2: Replicating and improving Experiment 1

3.1. Abstract

The present study aimed to replicate Experiment 1 but improve the design by controlling arousal, word frequency and list length. Participants viewed 48 words (positive, neutral or negative) followed by a cue instructing participants to remember or forget each item. A short delay (50 ms) or long delay (10 s) succeeded each word. At the end of the presentation, participants were asked to recall all words regardless of cue. Matching Experiment 1, there was a traditional DF effect and emotional items were more likely to be remembered than neutral items. However, this time the TBR positive stimuli were not recalled better than the TBR negative stimuli. Additionally, there was no significant effect for delay and no significant interactions.

3.2. Introduction

Experiment 1 may have been affected by a floor effect. This was controlled in Experiment 2 by reducing list length. The reasons behind this decision are discussed below. Word arousal and frequency were also controlled.

3.2.1. Emotion, arousal and valence

There are two aspects of emotionality: valence and arousal (Lang et al., 1993). Valence is used to describe the emotionality of stimuli and arousal is used to describe the intensity of the stimuli (Lang et al., 1997; Warren et al., 2008). Specifically, valence focusses on the pleasantness of stimuli whilst arousal focuses on their intensity (Warren et al., 2008). In Experiment 1, the primary focus was on

valence and the impact of valence on DF where arousal was uncontrolled. Yet this experiment looks at arousal and controls it, improving the word list in comparison to Experiment 1.

Within DF (Bjork,1970) there are numerous studies that focus on valence and the differences between the valences (e.g. Hauswald et al., 2010; Hamann, 2001; Nowicka et al., 2010; Wylie et al., 2008; Yang et al., 2012), as discussed in the two previous chapters. Most of these studies are based on high arousal negative and positive stimuli but low arousal neutral stimuli, and the end result is usually better memory for the emotional stimuli. Experiment 2 was thus used to better control the arousal levels of the stimuli.

3.2.2. Word frequency

Another important factor is word frequency. Within the first experiment, word frequency was not fully controlled and this may have had an influence on recall. The concept of word frequency in lexical tasks has received a lot of attention, though there are core differences within both recognition and recall tasks. In a typical recognition task, low frequency words (uncommon) tend to be remembered better than those that are of a higher frequency (common; Criss, Aue & Smith, 2011). Yet in recall tasks participants are more likely to recall the higher frequency words in comparison to the lower frequency words (Delosh & McDaniel, 1996; Hall, 1954; Sumby, 1963). It is therefore possible that word frequency could affect DF. This current study has matched words on frequency, improving experimental control.

3.2.3. List length and further influences

Additionally, the length of the list can influence recall. In standard recall tasks, participants are presented with one item at a time and then the items must be

recalled in the same order (immediate serial recall [ISR]) or in any order (immediate free recall [IFR]). Within ISR studies, short lists are normally used to present items and it is argued that within shorter lists, there is more chance of recalling items than within longer lists (Drewnowski & Murdock, 1980). Researchers have generally argued that as list length decreases, participants tend to use a forward serial recall strategy (Bhatarah et al., 2006; Murdock, 1968).

Ward et al. (2010) found that participants were able to choose where they would prefer recall (first or later serial positions) within the post-cued instruction condition. Specifically, if recall was at an earlier position, then higher recall of early list items would be observed, and when recall was towards the end of the list, recency effects were observed. Their second experiment also reported similar results. This suggests that the length of the list is important in predicting what can be recalled and needs to be accordingly handled or adjusted within a free recall task. Taking this argument into account, within Experiment 1 there was a large number words and this may have contributed to a possible floor effect (especially for the TBF words and neutral words). Therefore, within the current experiment, the word set was reduced and this was intended to improve overall recall scores.

3.2.4. The present study

By controlling arousal and word frequency, and shortening list length, this experiment combatted the issues with Experiment 1. It tested the following hypotheses:

H_1) Participants will recall more TBR words than TBF words.

H_2) Participants will be recall more emotionally valenced words than neutrally valenced words.

H_3) Participants will recall more words when there is a shorter delay in comparison to when there is a longer delay.

H_4) Participants will be more likely to recall emotional than neutral TBF words. Participants will also be more likely to recall TBR positive words over other TBR conditions.

H_5) Participants will be more likely to recall the emotional than neutral words when there is a time delay. However, given the faster forgetting of negative words in Experiment 1, this study also aimed to test whether that effect could be replicated.

3.3. Method

3.3.1. Participants

Undergraduate Psychology students were recruited from the University of Wolverhampton through the SONA participant pool, lecture invitations and emails. Using G*Power, the effect size was calculated based on the important cue and valence interaction from Experiment 1. This indicated that a minimum sample size of 40 participants was required based on an alpha value of .05 and 80% power. Thus, the study was carried out on 40 students with 37 females and 3 males (*M* age = 22.35, *SD* = 5.96). In addition, none of the participants from Experiment 1 took part in this experiment.

3.3.2. Materials

The paper-based materials were the same as Experiment 1, including an information sheet, informed consent sheet, a demographics questionnaire, a recall sheet and a debrief sheet. These were used to give participants details and information about the study and take their consent for the experiment.

For the actual experiment, 48 words were adopted from the ANEW list (Bradley & Lang, 1999). They were equally divided amongst the three valences: positive, negative and neutral. Importantly, positive and negative words were matched on arousal (Positive [*M* = 6.48], Neutral [*M*= 4.77], Negative [*M*= 6.63]). The mean arousal for neutral words was lower than the emotional words due to the difficulty of finding multiple high arousing neutral words.

Word frequency was also matched across valence, unlike Experiment 1: Positive *M* = 17.88, Neutral *M* = 17.94, Negative *M* = 17.06. The words were further divided according to time delay (50 ms or 10s), word length and cue (TBR and TBF). Each list was then carefully balanced to have a fair representation of each variable. The mean length of the words was 6.50. These words were shown to participants on a standard computer screen (19" HANNS.G HP191) using 'SuperLab' 5 software.

3.3.3. Design

The study used a repeated measures design and there were three IVs. The first IV was word valence, which had three levels (positive, negative and neutral). The second IV was the two cues (TBR and TBF) and the last IV was the time delay inserted after cues, which also had two levels (50 ms and 10s). The words used within the study were divided amongst cues but to ensure a fair representation of words for all participants, the words associated with the TBR cue for half of the participants were assigned to the TBF cue for the other half, and vice versa. The DV was the number of words that were correctly recalled. Ethical approval was granted by the Ethics committee of the University of Wolverhampton (Appendix 15).

3.3.4. Procedure

Each participant sat in front of a standard computer that was situated in a small experimental cubicle. Participants were either tested alone or with another participant, depending on the size of the lab room. At this point, the participants were given instructions and basic information regarding the experiment. If there were two participants in the same slot for the experiment, then any form of communication or conferring between them was forbidden. Furthermore, participants sat at opposite ends of the room to avoid any collusion.

An information sheet was handed to every participant followed by an informed consent page, which volunteers had to read and sign in order to take part in the experiment. After this, participants were given a demographics questionnaire to complete. Once these sheets were completed, they were handed to the researcher for secure storage. At this point, the researcher verbally presented the instructions to the participant.

The 48 words were then presented on the screen individually. The word order was randomized and each word was presented for 1.5 seconds. After the presentation of each word a cue (either TBR or TBF) was given for 1.5 s and followed by a designated time delay (50 ms or 10 s). After the word presentation, participants were asked to recall all the words within a time span of five minutes. Participants were given a recall sheet to manually write down the words. After the five minutes elapsed, the recall sheet was collected by the researcher and the participant was handed a debrief sheet to explain the nature of the study.

3.4. Results

The words were scored in the same way as Experiment 1, with proportions being used for the analyses. The Mean (*M*) and standard deviation (*SD*) was calculated for the different variables (see Table 3.1). Firstly, there was a traditional DF effect, with higher recall for TBR than TBF words. An emotionality bias was also uncovered, with positive words being recalled more than negative and neutral words in the short delay (see Table 3.1). Negative words were recalled more than the other two valences within the long delay. When comparing the two delays for both cues, there was generally a decline in recall when there was a long delay compared to a short delay. This was shown for all three valences.

Table 3.1.

Mean and standard deviation for recall according to cue, delay and valence.

	Short Delay			Long Delay		
Cue	Positive	Neutral	Negative	Positive	Neutral	Negative
TBR	.45 (.32)	.36 (.22)	.38 (.26)	.37 (.25)	.29 (.27)	.44 (.23)
TBF	.18 (.18)	.09 (.17)	.14 (.17)	.14 (.20)	.10 (.16)	.16 (.18)

A 2 x 2 x 3 repeated measures ANOVA was then conducted on the three IVs: Valence (positive, neutral and negative), delay (short and long) and cue (TBR and TBF). The DV was the proportion of words the participants correctly remembered. Once again, where the sphericity assumption was not met, the Greenhouse-Geisser correction was applied.

Firstly, a significant effect was found for cue (F [1, 39] = 80.68, p < .001, η_p^2 = .67), as the TBR cue (M = .38) resulted in better recall than the TBF cue (M = .13). Additionally, valence was also significant (F[2, 78] = 7.53, p = .001, η_p^2 = .16). Positive words were recalled on a similar level on average (M = .28) to negative words (M = .28), but neutral words were recalled the least (M = .21). A Šidák post-hoc test found positively valenced words were recalled more than the neutrally valenced words (p < 0.05) but not negatively valenced words (p = .987). The test also found negatively valenced words were recalled better than neutral word (p < .005). Additionally, the delay effect was non-significant (F[1, 39] = 1.33, p = .256, η_p^2 = .03), with similar recall for the short (M = .27) and long delay (M = .25) conditions.

As for the interactions, the interaction between delay and cue was non-significant (F[1, 39] = .68, p = .415, η_p^2 = .02). This was also the case for delay and valence (F[2, 78] = 2.52, p = .087, η_p^2= .06). While this interaction was approaching significance, negative words were less susceptible to forgetting over time, which does not support findings from Experiment where negative words underwent rapid forgetting. Additionally, the important cue and valence interaction was non-significant (F[2, 78] = .34, p = .715, η_p^2 = .01) – see Figure 3.1 – as all three valences were recalled less following a TBF cue, and both positive and negative words were recalled at a similar rate for both cues. The three-way interaction was also non-significant (F[2, 78] = .56, p = .572, η_p^2 = .04).

Figure 3.1.

Mean proportion of words correctly recalled according to valence and cue with 95% confidence intervals.

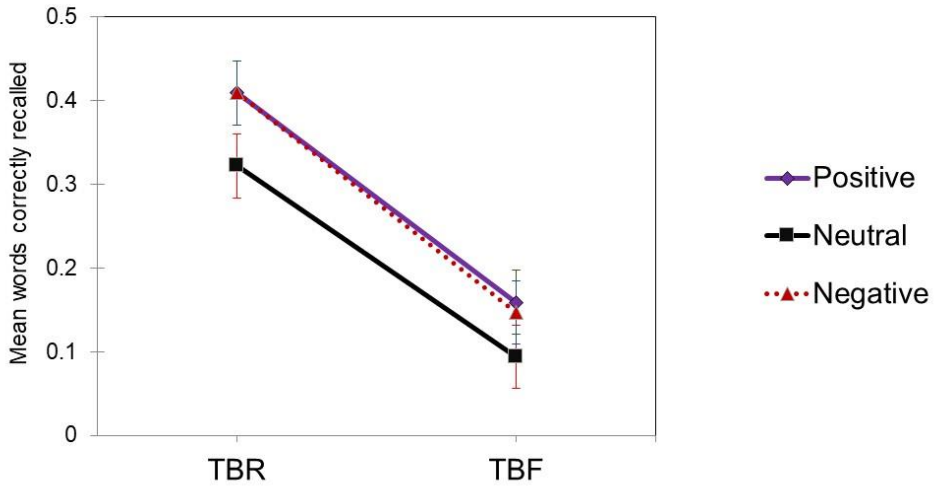


Table 3.2.

Mean and standard deviation for the computed DF scores according to valence.

Valence	*M*	*SD*
Positive	.25	.26
Neutral	.23	.20
Negative	.26	.24

Next, a DF score was computed by subtracting mean TBF from mean TBR, which quantified the amount of information lost following a TBF instruction (see Table 3.2). A repeated measures ANOVA was then conducted based on the DF score but no significant effect of valence was found (F[2, 78] = .34, p = .715, η_p^2 = .01).

Table 3.3.

Mean and standard deviation for the computed Cowan et al. (2001) scores according to valence.

Valence	M	SD
Positive	.45	.76
Neutral	.66	.44
Negative	.51	.57

Finally, Cowan et al.'s (2001) statistic was used to quantify the cue-driven forgetting rate. When applying this statistic to the current data, possible forgetting differed amongst each valence, ranging from 45% to 66% (see Table 3.3). A one-way repeated measures ANOVA was conducted but no differences were found in regards to valence ($F[2, 72] = 1.40$, $p = .254$, $\eta_p^2 = .04$).

3.5. Discussion

3.5.1. DF findings

This study focused on replicating the findings of the first experiment but with methodological improvements. This was achieved through greater control over word frequency and arousal, and by reducing the stimulus set size. Like Experiment 1, the results showed a traditional DF effect, supporting previous literature. Participants demonstrated that they could remember more TBR words than TBF words. This generally shows that individuals can intentionally forget when there is a cue prompting them to do so.

3.5.2. Valence and DF

In regards to valence, emotional words were recalled more than neutral words. Once again this may be caused by extra attention that is given to emotional stimuli during encoding (Herbert et al., 2008; Recio et al., 2014).

Both positive and negative words were recalled more than neutral words, yet the advantage of recall for positive words over negative words following a TBR instruction was missing, contrary to Experiment 1. In fact, there was minimal difference between the recall of positively and negatively valenced words, which has been supported by Bradley and Lang (1994). This may be due to the improved control over word arousal, leading to similar recall for positive and negative words. This may suggest that controlling arousal of emotional stimuli may lead to attention being given to both valences equally, though this is more directly assessed in Chapter 4.

Lastly, unlike Experiment 1, the cue by valence interaction was missing, and both the DF score and Cowan statistic analyses were non-significant, suggesting a strong and similar DF effect for all three valences.

3.5.3. DF, decay and recall

The post-cue delay also had a non-significant impact on recall. This may suggest that participants are able to prioritise the cue and act on it immediately. In terms of the interactions involving the delay variable, they were non-significant, including the important delay and cue interaction. This suggests that participants quickly prioritised instructions without being affected by the delays. However, unlike Experiment 1, this experiment did not show an interaction between delay and valence. This may be due to the improved word list, where arousal for negative

stimuli was better controlled, as well as the shorter word list, which may have also manipulated recall. Lastly, the interaction between all three variables (valence, delay and cue) was non-significant.

3.5.4. Additional influences, DF and valence recall

As for list length, though it was not formally tested, it does provide some insight into the results of this study. Shorter word lists lead to better recall (Grenfell-Essam et al., 2013) and proportionately more words were remembered in this experiment (*M* = .26, *SD* = .08) than Experiment 1 (*M* = .16, *SD* = .07).Yet reducing the list length did not impact DF as the effect was still clearly observed and participants were able to abide by the cue and recall the TBR words more successfully than TBF words.

Overall, the DF effect was replicated even though some of the other findings from Experiment 1 were not. These findings seem to be in line with some prior research, yet there are a few key points to highlight. Firstly, the stimuli were better matched on arousal, length and frequency across word lists. However, it is important to acknowledge that though these findings support the idea that emotionally valenced words are recalled better, it also shows that all three valences are susceptible to DF, and DF was not influenced by the passage of time (matching Experiment 1).

Additionally, whilst arousal was controlled here, there was no analysis or comparison of high and lower arousal words. Thus, in order to fully understand the previous results of Experiment 1 and this experiment, it is necessary to investigate arousal and its influence on DF and valence. Lastly, exploring individual differences may also help assess possible reasons for discrepant DF effects as outlined in

Chapter 1. In regards to valence, sex differences can play a role in emotion and emotion processing (Wester et al., 2002), which may be an important factor within these DF experiments.

3.5.4. Conclusion

Participants were capable of intentionally forgetting valenced information. However, the present experiment did not replicate the positivity bias of Experiment 1. In addition, the non-significant findings for the delay and the interactions implies that there may be additional factors that influence DF. Indeed, this study helps to establish how strong DF is, yet the inconsistent interactions between this experiment and Experiment 1, as well as differences in the 'positivity bias', highlights the need for further investigation of other impacting variables.

Chapter 4.

Experiment 3a: The impact of sex differences and arousal

4.1. Abstract

As shown in the previous two chapters examining DF, the stimuli used seem to be important. This experiment will further help determine how the stimuli can affect the DF effect. The first experiment found a positivity bias for TBR but not TBF items, yet this was not replicated within Experiment 2. This would suggest inconsistencies in the results which need to be further addressed. This study aimed to replicate the previous experiment while also directly manipulating arousal and investigating possible sex differences. Online experimental software was used to run the experiment and the results replicated the strong DF effect from the previous two experiments. The interactions were non-significant, resembling Experiment 2, though positive and negative words were recalled better than neutral words. However, differences between positive and negative words were non-significant (as found in Experiment 2). Arousal was also significant, with higher arousal words being recalled better than lower arousal words. Sex was non-significant. In summary, DF is a robust effect and all three valences were subjected to DF. Yet there was no evidence for sex differences within the DF task.

4.2. Introduction

4.2.1. Valence and Arousal

Following the previous studies, this study also intended to examine DF according to valence. The potential role of arousal was considered in Chapter 3 but

was directly manipulated in this experiment by using words with different levels of arousal. The prior studies did not manipulate arousal as an IV, whereas the present study did, with words being assigned to ‘higher’ and 'lower' categories of arousal to test any influence on DF. This is important, as higher arousal words may influence the DF effect for each valence.

Looking back at the first experiment, word arousal was not controlled across all the word categories and the other domains, which may have led to certain high arousal words being recalled better. Experiment 2 aimed to better control arousal and to some degree matched positive and negative words on arousal, but any effects on DF were not directly tested. Thus, looking at the above differences between Experiments 1 and 2, it is important to test the role of arousal in the DF task.

Some research has shown that differences within valence are more prominent than differences within arousal, especially regarding visually presented words (Bradley & Lang, 1994). This has been observed within studies using non-English words where both dimensions are highly correlated. In fact, Herbert et al. (2008) tested arousal using 180 adjectives, which included highly arousing pleasant, highly arousing unpleasant and low arousing neutral adjectives. Herbert et al. (2008) found that emotional words were processed at an early time window after word presentation, with a main effect for valence. Their results identified that emotional arousal drives the capture of attention (Herbert et al., 2008).

However, within these previous studies, stimuli are chosen to have maximum valence and arousal (Lang et al., 1997), with a mixture of high arousal positive and negative words, but low arousing neutral words. This creates an emotionality bias within recall and may suggest that arousal influences the recall of different valences.

4.2.2 Arousal and DF

Arousal may also influence DF for each valence. This was tested by Gallant and Dyson (2016), who used the item-method of DF and words that were high and low in arousal and varied in valence (positive, neutral and negative). They also looked at electrical brain activity that was elicited in response to the words and cues, particularly during encoding.

Gallant and Dyson (2016) found a traditional DF effect with higher hits for TBR than TBF items. They also found valence interacted with cue and arousal as part of a three-way interaction. Their results showed higher hits for negative words than positive or neutral words for both TBR and TBF cues. Additionally, there were higher hits for high arousal words compared to lower arousal words. In particular, there was better recognition for the high arousal negative TBF words. Yet differences between TBR and TBF negative words were minimal, regardless of arousal. Furthermore, reduced suppression for negative words within both types of arousal in comparison to other valences was found.

Another study that focussed on arousal, valence and DF was Bailey and Chapman (2012). They found a significant amount of high arousal words were recalled in comparison to lower arousal words. Additionally, arousal and emotion were also seen to interact with cue, with less DF for high arousal emotional stimuli. A smaller DF effect was also found for high arousal negative words in comparison to the positive words. This would suggest that arousal does influence the recall of emotional stimuli and affect DF. However, it is also of importance to note that Bailey and Chapman (2012) and Gallant and Dyson (2016) used a recognition task rather than recall, whilst this current experiment explores free recall.

Thus, based on the literature above, arousal may affect DF, especially for positively valenced and negatively valenced stimuli. This may suggest higher arousal words can capture attention and so be less susceptible to DF effects in comparison to lower arousal words. This may be particularly relevant when factoring in valence, as certain valence types may lead to reduced DF when arousal is also high (as somewhat seen from Gallant & Dyson, 2016). Ultimately, manipulation of arousal in this study may help explain why the previous experiments (1 and 2) had conflicting results. More broadly, this study may provide further insights into the discrepancies within the DF and emotional valence literature.

4.2.2. Valence, sex differences and DF

Another element for consideration in regards to valence and DF is participant sex. It has been suggested that participant sex can have a strong influence on valence, valence processing and general valence recall (Bradley, et al., 2001; Chang, Ku & Chen, 2018; Fischer et al., 2004; Wang et al., 2017). In fact, the previous two experiments were conducted on participants who were predominantly female, and this may have influenced the end results. For example, Young et al. (2013) looked at differences in recall for the two sexes, especially for emotional events. They looked at autobiographical memory recall, using all three valences as cue words, and then compared responses to a semantic memory task which involved categories of emotionally valenced cues. They found that females had better recall for the negatively valenced autobiographical memories and lower recall for the positively valenced ones in comparison to the males. However, there was no difference with ratings of arousal, vividness and age in relation to memory. Yet

Young et al. (2013) found some neurological differences between females and males.

This finding has been mirrored in other studies (Kogler et al., 2015; Lee et al., 2014), suggesting that sex differences may play an important role in emotion-based tasks, where some authors argue for an advantage for females in these emotion tasks (Lee et al., 2013; Harness et al., 2008). For example, females are more receptive to negative, emotional or stressful stimuli than males (Kring & Gordon, 1998; Kret & De Gelder, 2012; Stevens & Hamann, 2012). Yet others have argued for a male advantage or no sex differences (Sawada et al., 2014; Voyer et al., 2017).

Within DF, contradictory findings concerning emotional stimuli may be due to the fluctuating numbers of males and females. However, to date no study has directly investigated the role of sex differences in DF while also manipulating valence and arousal. It is therefore necessary to understand how each sex recalls words of different valence within the DF task. It would also help to understand whether having a majority of females within the previous experiments affected the results, as different sexes may deal with intentional forgetting of emotional stimuli in different ways. Hence it is important to test 'sex' and arousal effects on DF.

4.2.3. The present study

To understand the conflicting results within DF that have been reported in the previous chapters, this study tested sex differences and manipulated the arousal level of the stimuli, being one of the first to do so. Positive, negative and neutral words were categorised as high or low arousal and the effects on DF examined.

The following hypotheses were tested:

H_1) Participants will recall more TBR words than TBF words.

H_2) Participants will recall more emotional than neutral words.

H_3) Participants will recall more high arousal than low arousal words.

H_4) Females will recall more negative words than males.

H_5) Females will recall more high arousal words than males.

H_6) Participants will be more likely to recall high arousal TBF words than low arousal TBF words.

H_7) Participants will recall more emotional than neutral TBF words.

H_8) There will be a reduced DF effect within females for emotional words in comparison to males.

4.3. Method

4.3.1. Participants

Based on the previous G* Power analysis and previous study, a sample size of 40 participants were required as a minimum. However, the aim was to recruit 50 participants based on the need to boost the sample size and replicate Experiment 1. Participants were recruited via SONA. Additionally, participants were informed about the experiment through open lecture invitations, emails and social media invites. The website 'Gorilla' (www.gorilla.sc; Anwyl-Irvine et al., 2019) was used to create the experiment and collect responses. In total, there were 318 responses, including 263 drops outs/ incomplete responses. This also includes 243 consenting participants, meaning 75 individuals dropped out straight after the information sheet had been shown. In the end, 55 correct and completed responses were used, with 33 females and 22 males (*M* age = 25.81, *SD* = 7.49).

4.3.2. Materials

A web-based experiment builder 'Gorilla' was used to create the experimental task as well as an information page, an informed consent page, a demographics questionnaire, a recall page and a debrief page.

Table 4.1

Means for the category of arousal according to valence and cue.

	TBR		TBF	
Valence	High arousal	Low arousal	High arousal	Low arousal
Positive	6.97	3.95	6.93	3.98
Neutral	5.62	3.75	5.65	3.76
Negative	7.03	4.11	7	4.15

The task included 72 words, which were divided between the domains of arousal (low and high) and valence (positive, negative, neutral [See Table 4.1]). In order to categorise words appropriately, thresholds for arousal were based on existing literature. Words with mean arousal below 5 were classed as ‘low arousal’ and means above 5 were classed as ‘high arousal’. These words were adapted from the ANEW database (Bradley & Lang, 1999). Effort was also made to equate frequency amongst the other variables, where the mean was calculated (TBR = 31.31, TBF = 32.1). Mean length of the words was also calculated across all the variants (4.53). Both words and cues were shown in an Arial font, size 72.

4.3.3. Design

The study used a mixed experimental design and four IVs were tested: word valence (positive, negative and neutral), cue (TBR and TBF), arousal level (low and high) and sex (male and female). The DV was the proportion of correctly recalled words. Ethical approval was also granted by the Faculty of Education, Health and Wellbeing Ethics Committee of the University of Wolverhampton (Appendix 15).

4.3.4. Procedure

Due to the nature of this online study, access to the study was given through the experimental website 'Gorilla'. The task was available through any medium that could access the internet, such as phones, tablets, laptops and so on. Hyperlinks and invitations were sent out through email and social media forums. Participants were firstly directed to an information page, which explained the study, and this led to an informed consent page that reiterated important points about the study. After full consent was given, participants moved onto the demographics page and reported their sex and age. Participants were then shown an instruction page to start the experiment.

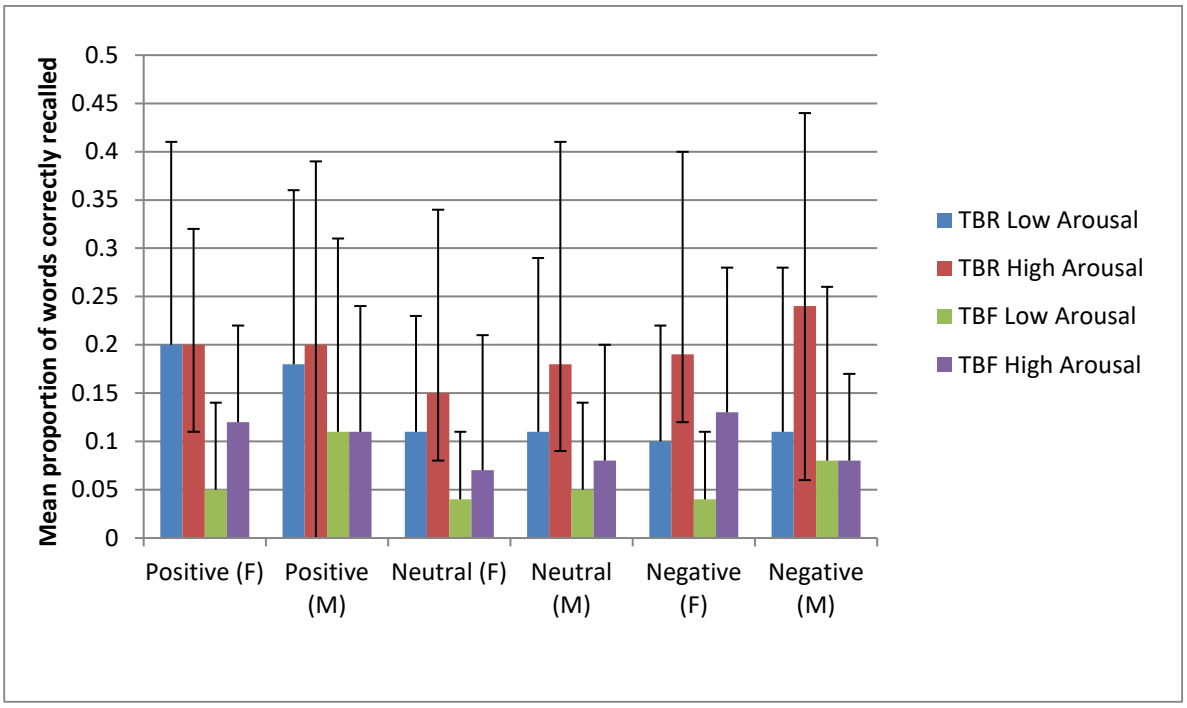
The experiment presented words on the screen, individually, for 1.5 s. Each word was then followed by a cue (either TBR or TBF), also shown for 1.5 s. The word order was randomised for every participant. After all 72 words had been shown, the participants were redirected to a recall page where they typed all the words they could remember into a box. Participants had 5 minutes to complete recall but were able to move on sooner if they had completed the task. Finally, the participants were directed to a debrief page and informed about the purpose of the study. Participants were asked to then submit or withdraw their data, which completed the study.

4.4. Results

Means (*M*) and standard deviations (*SD*) for the amount of correctly recalled words were calculated, following the approach outlined in Experiment 1. Results are shown in Figure 4.1. Firstly, higher arousal words were recalled better than lower arousal words for both sexes. In retrospect, both males and females had a similar performance, where an emotionality bias with a strong DF effect was recorded. However, for females there was similar recall within TBR positive words for high and low arousal, yet for males the TBR positive high arousal words seemed to be better recalled. Conversely, for negative words the higher arousal words were recalled better than the lower arousal words for both sexes (see Figure 4.1).

Figure 4.1.

Mean (and standard deviation) proportion of correct recall according to cue, valence and arousal type for females (F) and males (M).



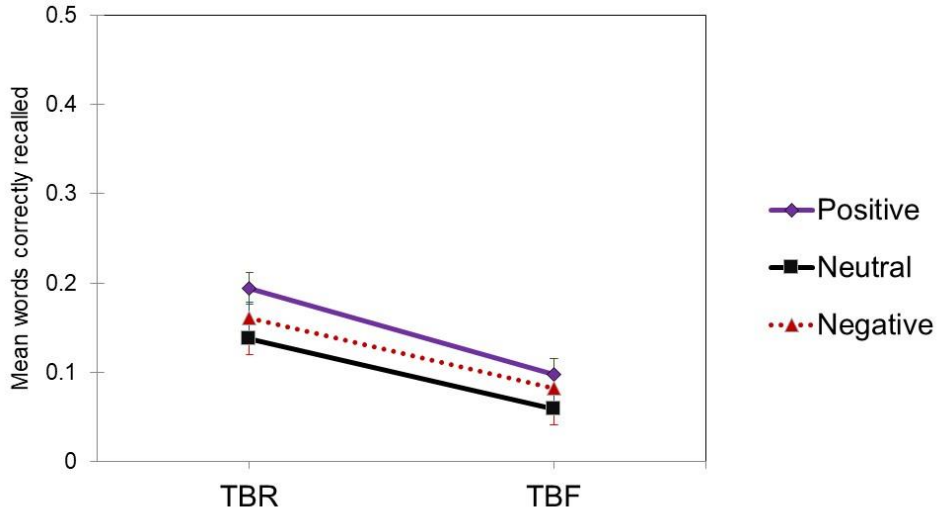
A mixed ANOVA was then conducted on the four IVs: valence (positive, negative and neutral), cue (TBR and TBF), arousal (low and high) and sex (male and female). These variables were tested on the proportion of correctly recalled words (where the sphericity assumption was not met, the Greenhouse-Geisser correction was applied).

For the main effects, the ANOVA showed a significant effect for cue (F[1, 53] = 28.34, $p < 0.01$, $\eta_p^2 = .35$), suggesting a traditional DF effect. TBR words ($M = .17$) were recalled more than TBF words ($M = .08$). Valence was also significant (F[2, 106] = 7.87, $p < 0.01$, $\eta_p^2 = .13$) with a Šidák post hoc test showing a significant difference between the positive and neutral words ($p = .001$), but a non-significant difference between both the positive and negative words ($p = .120$) and the neutral and negative words ($p = .172$). Arousal type was significant too (F[1, 53] = 31.25, $p < 0.01$, $\eta_p^2 = .37$), with high arousal words being recalled better ($M = .15$) than low arousal words ($M = .10$). Lastly, for sex, there was a non-significant effect on recall (F[1, 53] = .36, p = .559, $\eta_p^2 = .01$), suggesting that both males ($M = .13$) and females ($M = .12$) had similar recall performance.

All interactions were non-significant, including the important interaction between valence and cue (F[2, 106] = .32, $p = .725$, $\eta_p^2 = .01$ [See Figure 4.2]). Within this experiment, all three valences underwent DF.

Figure 4.2.

Mean proportion of words correctly recalled according to valence and instruction with 95% confidence intervals.



Other non-significant interactions included valence and arousal (F[2, 106] = 2.28, p = .107, η_p^2 = .04), valence and sex (F[2, 106] = .12, p = .888, η_p^2 = .002), cue and arousal (F[1, 53] = .003, p = .958, η_p^2 = .04), cue and sex (F[1, 53] = .76, p = .389, η_p^2 = .01), arousal and sex (F[1, 53] = .51, p = .477, η_p^2 = .01), cue, valence and sex (F[2, 106] = .89, p = .416, η_p^2= .02), cue, valence and arousal (F[2, 106] = 1.67, p = .193, η_p^2 = .03), cue, arousal and sex (F[1, 53] = 3.46, p = .068, η_p^2 = .06), valence, arousal and sex (F[2, 106] = .41, p = .668, η_p^2= .01) and, lastly, cue, valence, arousal and sex (F[2,106] = .65, p = .524, η_p^2= .01).

A DF score was also calculated, based on valence (see Table 4.2). A repeated measures ANOVA was then conducted on the DF score to compare valences, but no significant effect was found (F[2, 108] = .58, p = .560, η_p^2 = .01).

Table 4.2.

Mean and standard deviation for the computed DF scores within each of the valences.

Valence	M	SD
Positive	.10	.16
Neutral	.08	.16
Negative	.08	.15

Lastly, the method adapted from Cowan et al. (2001) was used to quantify the cue-driven forgetting rate, based on the amount of information that could be forgotten. The possible forgetting differed amongst each valence, ranging from >35% to over 50% (see Table 4.3). A one-way repeated measures ANOVA was then conducted on the forgetting rate and no differences were found (F[2, 62] = .76, p = .474, η_p^2 = .02).

Table 4.3.

Mean and standard deviation for the computed Cowan et al. (2001) scores within each of the valences.

Valence	*M*	*SD*
Positive	.38	.66
Neutral	.53	.74
Negative	.39	.55

4.5. Discussion

4.5.1 Valence, Arousal and DF

This experiment aimed to assess whether arousal and sex could affect DF for different valences. Once again, a traditional DF effect was found, with TBR words being more likely to be recalled than TBF words. This was consistent with the previous two experiments. As for valence, there was better recall of emotional words, which seems to partly support Experiment 1, with results showing better recall for positive than neutral words. Yet unlike Experiment 1, there was no support for better recall of positive words over negative words, though this finding was in line with Experiment 2. Arousal itself had a strong influence, with high arousal words being recalled better than low arousal words. However, all interactions were non-significant.

4.5.2. Arousal and DF

Gallant and Dyson (2016) previously investigated arousal and DF and reported similar results to this study, yet these current results do not support the existence of a cue and arousal interaction which Gallant and Dyson (2016) found. This may be due to various reasons, however Gallant and Dyson (2016) used recognition as their retrieval method whereas this study used recall, which as pointed out within Chapter 1 may be an important factor. Bailey and Chapman (2012) also looked at arousal and DF, where they divided words into higher and lower arousal categories. Their results indicated more recall for higher arousal items, as well as showing more DF for neutral words and less DF for emotional words when arousal was higher. Once again, however, this study used a recognition task and indicated arousal interacted with cue and emotion. Given the current study differed from the

previous studies in the retrieval task, it would be interesting to see whether this study can be replicated using a different retrieval method, especially when the chances of any output interference can be eliminated (see Chapter 1).

4.5.3. Valence and sex differences.

In regards to participant sex, the results showed that it did not affect overall recall, unlike previous research findings (Bradley, et al., 2001; Chang et al., 2018; Fischer et al., 2004; Kogler et., 2015; Lee et el., 2014; Wang et al., 2017). Young et al. (2013) observed that women are more likely to recall negative stimuli than men, but this was not seen in the results of this study. In fact, results showed that both sexes were able to successfully follow cues, with TBR words being recalled more than TBF words. Young et al. (2013) also found no difference within arousal ratings and vividness, which further supports the results from this study, as neither males or females were able to better recall one of the valence dimensions over the others, even for high arousal words.

The absence of an interaction between these two variables further supports the idea that there may be other factors that influence or manipulate DF for different valences. Additionally, though sex differences were not found, there was a general recall bias for emotional stimuli for both sexes, especially for positive words. This supports the idea that emotional stimuli are better processed. This is not only true for females (Kring & Gordon, 1998; Kret & De Gelder, 2012; Stevens & Hamann, 2012) but for males too. However, what was not considered within this study was the rate at which the emotional material could be processed as Lee et al. (2013) has outlined.

4.5.4. Considerations

While this study built on the task used in Experiments 1 and 2, the fact that it was done online through different mediums in various uncontrolled environments is a potential limitation. Specifically, the experimenter had less control over events in comparison to previous experiments. However, the fact that the DF effect was consistent is encouraging and shows that the results are in line with previous research.

Experiment 3b: The impact of output interference and cued recall

4.6. Abstract

This experiment intended to replicate the previous experiment while also reducing any output interference that may have been present in the free recall procedure used in earlier experiments. Thus, this experiment focused on repeating Experiment 3a, but using cued recall instead of free recall. Results showed that using cued recall can lead to an absent or even reversed DF effect. This seemed to be true for both emotional valences but not for neutral words. Positive words were recalled more than negative words, with arousal being non-significant. Arousal also seemed to interact with some of the other variables and played an important role. The negative words in particular were shown to have an enhancement at recall for TBF.

4.7. Introduction

4.7.1. Output Interference, recall and DF

It has been argued that recall of learnt material can interfere with, and impair, memory for other items (interference). One form of interference is output interference, where an item's recall within a list declines in probability based on the position it is in a sequence (Smith, 1971). Some studies argue that having cues alongside the repeated retrieval of items based on those cues can lead to forgetting of the non-practised items (Anderson, Bjork, & Bjork, 1994; Roediger, 1973), similar to RIF (Retrieval Induced Forgetting). This raises questions about the role of output interference in DF, especially where free recall is employed. The TBR words may dominate within memory, which makes it easier to recall the TBR items first, which

interferes with recall of TBF items (Aguirre et al., 2020). This may be even more relevant when considering valence, as output interference is said to be relevant to the associative strength between the item and the cue (Raaijmakers & Shiffrin, 1981). Having a certain stimulus that is strong in arousal and emotion may lead to an advantage within recall for some stimuli, as some items become more accessible than others.

The possible role of output interference raises a broader issue about the underlying logic of DF tasks as applied to valence. Retention of emotional and neutral material is assessed in relation to TBR and TBF cues, but the former is typically remembered much better than the latter, particularly in free recall. This poses questions as to whether there would be a difference within the DF effect if a different method of retrieval was used, such as cued recall. Inserting a cued recall method of retrieval could allow participants to more easily access the TBF items, leading to a better chance of understanding if the words are actually intentionally forgotten or are a product of some other mechanism. Output interference offers an alternative explanation for DF and contrasts with rehearsal and inhibition theories. Though this thesis does not intend to look at the mechanisms of DF directly, it is important to acknowledge that output interference could boost recall of TBR, compared to TBF, items, and therefore contribute to DF.

4.7.2. Aims

To reduce the likelihood of output interference obscuring the DF results, as well as better controlling unfair differences within the TBR and TBF scores based on the TBR advantage, Experiment 3a was replicated, but free recall was replaced with a

cued recall task. Previous hypotheses H_1, H_2, H_3, H_4 and H_6 were tested. However, due to the dismissal of sex differences within the last experiment, sex differences were not tested here (removing H_5 & H_8).

4.8. Method

4.8.1. Participants

Based on the previous study, 50 participants were required as a minimum. In total there were 237 responses, including 185 dropouts/ incomplete responses – of which only 150 consented to take part. In the end, 52 correct and completed responses were used, with 46 females and 5 males (*M* age = 31.79, *SD* = 10.13).

4.8.2. Materials,

This experiment replicated Experiment 3a in terms of the materials and equipment used. However, a cued recall method of retrieval was used (see Section 4.8.4).

4.8.3. Design

The study used a mixed experimental design and three IVs were tested: word valence (positive, negative and neutral), cue (TBR and TBF), and arousal level (low and high). The DV was the proportion of correctly recalled words. Ethical approval was also granted by the Ethics committee of the University of Wolverhampton (Appendix 15).

4.8.4. Procedure

The procedure was once again replicated using the same approach and task as the previous experiment. However, rather than a free recall test, participants were given a cued recall task where each word was partially re-shown with only the first

three letters displayed, i.e. ‘hos_ _ _ _ _ ’ (hospital). Underneath each word, the participant guessed the blanks and typed in the correct word. Once they typed in their response, participants clicked ‘next’ to receive the next word until all had been completed. These words were randomised during the cued recall task. There was no time limit for this as per previous experiments that used free recall with a time limit of 5 minutes. After the participants had completed the cued recall task, they were given the option to either withdraw their responses or continue and submit their results. This led to a debriefing page.

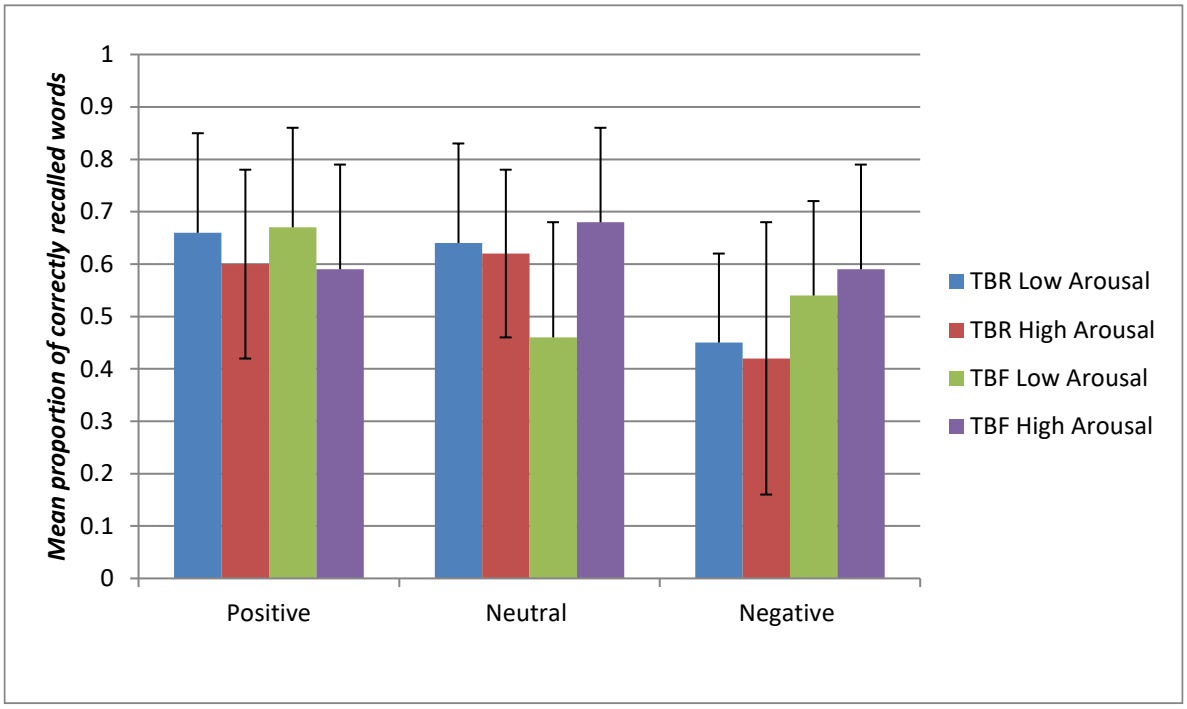
4.9. Results

Mean (*M*) and standard deviation (*SD*) for the amount of correctly recalled words was calculated. The data was scored in a similar way as Experiment 3a, however, due to the cued recall procedure some participants only entered in the missing letters, .i.e. ‘pital’ to the cue ‘Hos____’. Words were only considered correct if they were correctly spelt, whether participants wrote a partial word or the full word. The spelling itself had to reflect the word being recalled.

Results are shown in Figure 4.3. Firstly, high arousal neutral words were more likely to be recalled than positive and negative words, with negative words being the least likely to be recalled. For positive words, low arousal TBF words were recalled better than low arousal TBR words, whereas high arousal TBR words were recalled better than high arousal TBF words. For neutral words, TBF high arousal words were better recalled than the equivalent TBR words. Yet it was the TBR low arousal words that were recalled better than the TBF low arousal words. As for the negative words, the TBF words fared better within recall and high arousal words were better recalled than low arousal words.

Figure 4.3.

Mean (and standard deviation) proportion of correct recall according to cue, valence and arousal type.



A repeated measures ANOVA was then conducted on the three IVs: valence (positive, negative and neutral), cue (TBR and TBF) and arousal (low and high). These variables were tested on the proportion of correctly recalled words (where the sphericity assumption was not met, the Greenhouse-Geisser correction was applied).

For the main effects, the ANOVA showed a non-significant effect for cue (F[1, 51] = 3.26, p = 0.07, η_p^2 = .06), suggesting an absent DF effect (TBR M = .56, TBF M = .59). Valence was significant (F[2, 102] = 33.64, p < 0.01, η_p^2 = .40), with a Šidák post hoc test showing a non-significant difference between the positive (M = .63) and neutral words (M = .60, p =.106), but a significant difference between both the

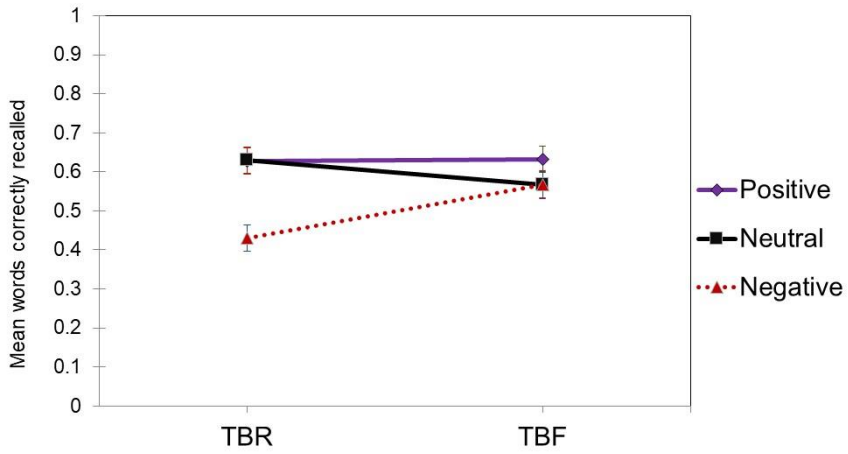
positive and negative words (*M* = .50, *p* < .001) and the neutral and negative words (*p* < .001). Arousal type was non-significant (*F*[1, 51] = .60, *p* =.443, η_p^2 = .01; high arousal: *M* = .58, low arousal: *M* = .57) .

All the interactions were significant: cue and arousal (*F*[1, 51] = 13.03, *p* = .001, η_p^2 = .20 [See Appendix 6]), valence and arousal (*F*[2, 102] = 17.07, *p* <.001, η_p^2 = .25 [See Appendix 6); cue and valence (*F*[2, 102] = 17.02, *p* < .001, η_p^2 = .25 [see Figure 4.4.]). The focus will be on the three-way interaction as it captures the other two-way interactions. However, due to the theoretical relevance of the cue and valence interaction, it will also be explored for consistency.

Firstly, the interaction between cue and valence showed that positive words were more likely to be recalled than negative words, but whilst the negative words were better retrieved for the TBF cue, the positive words showed a similar rate of recall for both cues. The neutral words were more likely to be recalled than the negative words for the TBR cue, but not TBF, and they showed a typical decline from TBR to TBF.

Figure 4.4.

Mean proportion of words correctly recalled according to valence and cue. Error bars show 95% CIs calculated according to the method of Jarmasz and Hollands (2009).



To explore this interaction, paired-sample *t*-tests were conducted, with the *p*-value being adjusted using the Holm-Šidák correction. There was a non-significant difference (*t*[51] = .07, *p* = .945, *r* = .01) between the TBR positive (*M* = .63, *SD* = .14) and TBR neutral words (*M* =.63, *SD* = .14). However, TBR positive words were more likely to be recalled than the corresponding negative words (*M* = .43, *SD* = .16, *t*[51] = 8.45, *p* < .001, *r* = .76). TBR negative words were also less likely to be recalled than TBR neutral words (*t*[51] = -7.87, *p* < .001, *r* = .74). As for the TBF positive words (*M* = .63, *SD* = .15) and the TBF neutral words (*M* = .56, *SD* = .15), there was a significant difference (*t*[51] = 3.16, *p* = .01, *r* = .40), with better recall of the positive words. The TBF positive and TBF negative comparison (*M* = .57, *SD* = .16) was non-significant (*t*[51] = 2.27, *p* = .08, *r* = .30). Lastly, the TBF neutral and TBF negative comparison was also non-significant (*t*[51] = .096, *p* = .924, *r* = .01).

The interaction between cue, valence and arousal was significant (*F*[2, 102] = 7.855, *p* =.001; η_p^2 = .133 [see Figure 4.3]). To further look at this interaction, two

repeated measures ANOVAs were conducted for each arousal level. For the high arousal words, cue was significant (F[1, 51] = 16.34, p < .001, η_p^2 = .24), with TBF words (M = .62) being recalled better than TBR words (M = .55). Valence was also significant (F[2, 102] =19.74, p < .001, η_p^2 = .28), with a Šidák post hoc test showing a significant difference between the positive (M = .60) and neutral words (M = .65, p =.022), with neutral words being recalled the most. There was also a significant difference between the positive and negative words (M = .50, p = .003), with better recall for the positive words, and between the neutral and negative words (p < .001), with better recall for the neutral words.

Within the high arousal analysis, the interaction between cue and valence was also significant (F[2, 102] = 5.32, p =.006, η_p^2 = .09) and a further paired t-test indicated no difference between TBR positive (M = .60, SD = .18) and TBR neutral words (M = .62, SD = .16; t[51] = .65, p = .521, r = .09). However, there was a significant difference between the TBR positive and TBR negative words (M = .42, SD = .26; t[51] = 4.05, p < .001, r = .49), with the positive words being recalled more. There was also a difference between the TBR neutral and TBR negative words (t[51] = 4.73, p < .001, r = .55), with the neutral words being recalled more.

Next, the TBF condition was considered. Recall for positive (M = 59, SD = .20) and neutral (M = .68, SD = .18) words was significantly different (t[51] = 3.72, p = .002, r = .46), with better recall for the neutral words. There was no difference between positive and negative recall (M = .59, SD = .20; t[51] = .87, p = .931, r = .01), but neutral words were more likely to be recalled than negative words (t[51] = 2.43, p = .05, r = .32).

The second repeated measures ANOVA for the low arousal conditions showed that cue was non-significant (F[1, 51] =1.39, p = .243, η_p^2 = .03), with TBR

(*M* = .58) and TBF (*M* = .56) items being recalled at a similar rate. Valence was significant (*F*[2, 102] =135.84, *p* < .001, η_p^2 = .41), with a Šidák post hoc test showing a significant difference between the positive (*M* = .66) and neutral words (*M* = .55, *p* <.001), with positive words being recalled the most. There was also a significant difference between the positive and negative words (*M* = .49, *p* < .001), with better recall for the positive words, and between the neutral and negative words (*p* < .016), with better recall for the neutral words.

The interaction between cue and valence was also significant (*F*[2, 102] = 27.82, *p* < .001, η_p^2 = .35). For low arousal words, further paired *t*-tests indicated a non-significant difference between TBR positive (*M* = .66, *SD* = .19) and TBR neutral recall (*M* = .64, *SD* = .19; *t*[51] = .57, *p* = .575, *r* = .08). However, there was a significant difference between the TBR positive and negative words (*M* = .45, *SD* = .17; *t*[51] = 7.97, *p* < .001, *r* = .74), with the positive words being recalled more. There was also a significant difference between the TBR neutral and TBR negative conditions (*t*[51] = 9.05, *p* < .001, *r* = .78), with the neutral words being recalled more.

For the TBF positive *(M* = .67, *SD* = .19) and TBF neutral (*M* = .46, *SD* = .22) comparison, there was a significant difference (*t*[51] = 6.62, *p* < .001, *r* = .68), with better recall for the positive words. A significant difference between TBF positive and TBF negative conditions *(M* = .54, *SD* = .18; *t*[51] = 4.23, *p* < .001, *r* = .51) was also found, with positive words being recalled more. Lastly there was a significant difference between the TBF neutral and TBF negative conditions (*t*[51] = 2.99, *p* = 0.01, *r* = .39), with better recall for the negative words.

An additional DF score was computed to compare valences based on arousal and assessed in a 2 (arousal: high vs. low) x 3 (valence: positive vs. neutral vs.

negative) repeated measures ANOVA. A significant effect was found for valence (F[2, 102] = 17.02, p < .001, η_p^2 = .25) and a post-hoc Šidák test confirmed a difference between positive (M = -.00) and neutral words (M =.06, p = .02), positive and negative words (M = -.13, p = .005) and neutral and negative words (p < .001). Arousal was also significant (F[1, 51] = 13.03, p = .001, η_p^2 = .20), with higher arousal (M =-.08) words showing the least amount of DF in comparison to lower arousal (M = .03) words. The interaction between valence and arousal was significant too (F[2, 102] = 7.00, p < .001, η_p^2 = .13) with positive words showing no difference for high arousal (M = .00, SD = .03) and low arousal (M = -.01, SD = .03; t[51] = .39, p = .699, r =.05) categories. Neutral words underwent less DF when high in arousal (M =.06, SD = .03) than low in arousal (M = .18 , SD = .03; t[51] = 5.17, p < .001, r = .59) and negative words showed reversed DF, though the difference between high arousal (M = -.17, SD = .05) and low arousal (M = -.10, SD =.03; t[51] = -1.76, p = .085, r = .24) was non-significant.

Finally, an additional Cowan score was computed and assessed with another 2x3 repeated measures ANOVA, comparing valence and arousal. A significant effect was found for valence (F[2, 92] = 15.75, p < .001, η_p^2 = .26), though a post-hoc Šidák test confirmed no difference between positive (M = -.13) and neutral words (M = .04, p = .098). However, there was a difference between positive and negative words (M = -.57, p = .003) and neutral and negative words (p < .001). The results also indicate that both positive and especially negative information are least susceptible to DF. Arousal was also significant (F[1, 46] = 19.86, p < .001, η_p^2 = .30), with higher arousal words (M = -.40) showing enhanced TBF recall in comparison to lower arousal words (M = -.04). However, the interaction between valence and arousal was non-significant (F[2, 96] = 2.37, p = .099, η_p^2 = .05).

4.10. Discussion

4.10.1. Valence, arousal and DF

The present study aimed to replicate Experiment 3a but replacing the free recall procedure with cued recall. Interestingly a traditional DF effect was not found here, with recall of both TBR and TBF words being similar. Furthermore, a reversed DF effect (TBF > TBR) was also uncovered for the high arousal neutral and negative words. This finding goes against the previous experiments and chapters. An effect of valence was again reported, with positive words being recalled better than negative words. Yet there was no difference in the recall of the positive and neutral words. However, in this experiment neutral words were remembered more than negative words, indicating that negatively valenced words may be less likely to be recalled in comparison to other valences. This suggests that emotional stimuli, especially negative stimuli, may not always capture attention better than neutral words.

Yet while arousal was involved in the effects reported above, it was non-significant in isolation, which may show that within a cued recall task, arousal only exerts an effect when interacting with other factors. These results conflict with Experiment 3a, where higher arousal words were recalled more and there was a clear DF effect. Additionally, arousal influenced valence effects, as positive words were recalled better than the other two valences when low in arousal. This indicates how DF changes when cued recall is used rather than free recall.

4.10.2. Output interference

Interestingly, with cued recall as the means of retrieval, the cue did not affect recall as reported in the previous experiments. Results indicated that negative words were harder to recall for individuals within the cued recall task, but negative items

also showed a reversal of DF, followed by a slight reversal for positive words and modest DF for neutral words. This highlights the critical role of the retrieval task used, as well as identifying that there may be some form of output interference at play. While, output interference may not fully explain the reason behind the reversed DF effect that was uncovered for some conditions, it may be relevant to why there was no overall DF effect. These findings therefore only partially support studies such as Aguirre et al. (2020), who argue that output interference does not play a role within DF. There is clear need for more research to be conducted in order to fully understand what role output interference may play and whether it has been underestimated as a underlying factor within recall.

4.11. General discussion

The current experiments investigated arousal within DF and valence. Comparing both experiments shows that the outcomes were strongly dependent on the retrieval method.

4.11.1. Free recall

The first experiment in this chapter (Experiment 3a) supported arguments that emotional stimuli more effectively capture attention than neutral stimuli (Herbert et al., 2008; Recio et al., 2014). This also replicated the other experiments that used free recall (Experiments 1 and 2). Additionally, Experiment 3a found that unlike the neutral words, positive words did not differ in recall according to arousal level (Keil et al., 2002). Compared to the second experiment (Chapter 2), even with the manipulation of arousal, similar results were attained. The positive words were recalled better than neutral, but not negative, words, but the absence of interactions within this experiment would suggest that arousal did not impact the effect of the

instructional cue. Each valence was susceptible to DF, with the traditional DF effect seeming to be consistently present within each free recall task.

4.11.2. Cued recall

Experiment 3b contradicted the results of Experiments 2 and 3a. While it supported the results of Experiment 1 in terms of a missing negativity bias, it also contradicts Experiment 1's DF effect. Furthermore, Experiment 3b showed unexpected successful recall of neutral words – more so than negative words. The latter finding thus challenged all previously conducted studies and findings, but cued recall may give neutral stimuli a fairer chance of recall. This further questions whether the emotionality bias is always evident as per previous literature (Barnacle et al., 2016; Barnier et al., 2007; Buchanan, 2007; Cahill & McGaugh, 1998; Challis & Kran, 1988; Chang et al., 2012; Doerksen & Shimamura, 2001; Joorman et al., 2005; Kranske & Kotz, 2007; McGaugh, 2003; Payne & Corrigan, 2005; Power et al., 2000; Talmi & McGarry, 2012; Talmi & Moscovitch, 2004; Zimmerman & Kelley, 2010).

Additionally, unlike the neutral words, the positive words did not differ in recall based on arousal (Keil et al., 2002). When compared to the second experiment (Chapter 2), even with the manipulation of arousal similar results were seen from this experiment. Yet within the cued recall task, the TBR high arousal words were recalled less than the TBF high arousal words. This may suggest that arousal does play a part as it did interact with DF within Experiment 3b. Unlike Experiment 2, Experiment 3b found better recall for positive words against negative, yet within Experiment 2 it was the positive words that were better recalled against neutral words.

4.11.2.1. Experiment 3a vs. Experiment 3b

Comparison of the two experiments reveals the strong impact of the retrieval method. In Experiment 3a the free recall task showed that all valences were susceptible to being forgotten with a similar amount of DF, yet within Experiment 3b's cued recall task, the classic DF effect was only found for low arousal neutral words. Additionally, negative words underwent a reversal of DF. Perhaps when there is a cue prompting the item to recall, it becomes harder to forget that item and the representation is stronger due to the individual visualising what to recall. Within free recall, the individual has no such prompt. This would to some extent explain why neutral words experienced steady DF even within the cued recall procedure, as they can be easily forgotten, whereas prompting a negative item in memory becomes harder to forget and "undoes" DF. Yet for positive and negative words, cued recall led to a reversal of DF, which may be due to ironic control processes (Wegner, 1994). That is, trying to control the DF process through cues encounters problems when there are visual cues prompting each word. The process itself turns into a reversed DF effect for the highly emotional content, i.e. something which is negative which is an opposite outcome of what was actually intended.

The study conducted by Gallant and Dyson (2016) on arousal, valence and DF is particularly relevant here. Their results showed a typical DF effect, which seemed to be prevalent in the previous two chapters, as well as Experiment 3a. This was profound even though the study used a recognition procedure, which goes against results of Experiment 3b where a reversal of DF was found for negative words. However, Gallant and Dyson did find a reduced DF effect for the negative words, which relates to Experiment 3b. Yet unlike Gallant and Dyson (2016), the negative words within the current study did not fare better than the neutral words

during retrieval, especially within the TBR condition. Additionally, within the current study's TBR condition, the positive words were recalled better than the negative words, suggesting there is some form of positivity bias. However, this is more prevalent within free recall whereas within cued recall this changes (see Chapters 1-3).

4.11.3. Considerations

Valence was indeed an influential factor in the DF effect, but it would be useful to understand why certain words are recalled better than others in the DF task. The previous experiments have assessed how other factors, such as arousal, can affect DF for the three valences, but this can be taken further by comparing abstract and concrete words, as this distinction would provide more insights into what can be intentionally forgotten. In fact, some research has shown a difference between concrete and abstract words in regards to lexical processing (Schwanenflugel et al., 1988) and general memory (Walker & Hulme, 1999). Yet there has been little effort to explore how these word types can influence DF in regards to valence. Additionally, it may be beneficial to take into account additional individual differences such as mood to decipher what may affect the recall of emotional stimuli within DF.

To conclude, intentional forgetting is possible in free recall but in cued recall it is dependent on valence and arousal.

Chapter 5.

Experiment 4: The impact of individual differences, concreteness and time

5.1. Abstract

This experiment followed up the previous experiments (experiments 1-3b). In addition to exploring DF and valence, this study examined whether individual differences (emotional reactivity and mood) and stimulus type (abstract and concrete concepts) influenced DF for the three valences. The role of time was also tested, but using a longer delay than Experiments 1 and 2. A total of 60 words, equally divided amongst valence (positive, negative and neutral), cue (TBR and TBF) and word type (concrete and abstract), were used. Each word was presented for 1.5 s followed by an associated cue. After all the words were presented, there was either a delay (10 mins) or no delay, and then participants were asked to recall as many words as possible, regardless of cue. Results found a standard DF effect, and emotional words were more likely to be recalled than neutral words. Mood was not associated with recall, yet emotional reactivity was correlated with recall in some conditions, though not with the DF effect. As for the stimuli, concrete words were recalled more than abstract words for both cues, yet both were subjected to DF. To conclude, even emotional concrete words are subjected to DF, though emotional reactivity had some connection with recall.

5.2. Introduction

5.2.1. Concreteness, valence and DF

There has been a variety of research that has looked at how abstract and concrete stimuli influence recall. The term 'abstract' is generally used when talking about emotional content or material that relates to ideology used to explain something, whereas 'concrete' describes things we experience based on what we perceive through the senses (Barsalou & Wiemer-Hastings, 2005; Crutch et al., 2013). Generally concrete concepts are more likely to be remembered than abstract concepts (Schwanenflugel et al., 1988; Paivio, 1991). This has been named the 'concreteness effect' and has generally been reported within many cognitive tasks, including free recall, translation (de Groot et al., 1994) and comprehension tests (Holmes & Langford, 1976).

The concreteness effect can be explained by two major theories: 'Dual Coding Theory' (Paivio, 1971) and 'Context Availability Theory' (Schwanenflugel et al., 1992). The dual coding theory (Paivio, 1971) argues that concrete words are easier to recall based on their visual properties (Altarriba, Bauer & Benvenuto, 1999). Alternatively, the context availability theory (Schwanenflugel et al.,1992) explains the concreteness effect through the contextual and circumstantial situation affecting stimuli (Kieras, 1978). This then suggests that the concrete words have an advantage at recall because they are more likely to be seen through a relevant context. Based on previous research on the widely reported concreteness effect, concrete words may also be less prone to DF in comparison to abstract words. Yet the concreteness effect has not always been reported (Bachoud-Lévi & Dupoux, 2003; Bonner et al., 2009; Bransford & McCarrell, 1974; Cipolotti & Warrington, 1995; Macoir, 2008; Papagno et al., 2009; Warrington, 1975).

Interestingly, abstract concepts are related to affective connotations (Skipper & Olson, 2014). In fact, the 'affective embodiment account' suggests that while concrete words are learnt through the senses, abstract concepts or words are learnt through emotion and its stimulants (Vigliocco et al., 2009). Therefore, are concrete or abstract stimuli more prone to being intentionally forgotten?

When considering both concepts (concrete or abstract), the role of imageability (the ability for a word to create a visual image) is crucial. Kousta et al. (2011) argued that both these concepts are correlated and by controlling imageability, abstract words can indeed be learnt quicker (Kousta et al., 2011).

Kousta et al. (2011) had participants view 40 abstract and 40 concrete words that were matched on other variables such as familiarity and context availability, but differed on concreteness. Imageability was also controlled. Additionally, participants had to complete a response test within trials. Kousta et al. (2011) found that abstract words were processed faster than concrete words, suggesting that the concreteness effect can indeed be eliminated when imageability is controlled. It also indicates that abstract words are related to valence, and failure to account for valence within these studies can be problematic. This is important to consider as it has been seen that, within DF, valence influences recall. Testing the relationship and impact both word categories have may be a key point in understanding valence and recall within DF.

Altarriba et al. (1999) also looked at emotion and concrete and abstract words. They conducted the study with seventy-eight undergraduate participants who rated words on the three scales of concreteness, imageability and context availability. They found that there was a difference in ratings for emotional words that were less concrete and low in context availability, in comparison to both abstract and concrete words. While the emotion words had higher 'imageable' ratings than

abstract words, this was not the case for the concrete words. Words that are valenced and classed as emotional may indeed affect recall, but it is also of importance to consider this within the dimensions of concreteness.

In summary, word concreteness is an important consideration in regards to how individuals perceive each valence, especially within DF, and in Experiment 1 TBR positive words were recalled better than other valences (Chapter 2).Yet in Experiments 2 and 3a, both positive words and negative words were recalled at a similar rate. However, in Experiment 3b, positive words were only better recalled than negative and not neutral words. In fact, categorising stimuli as abstract may make the negative words less susceptible to DF due to reinforcement of the underlying valence. Considering the element of concreteness, it may be that due to previous studies failing to incorporate and control it, concreteness may have played a role in the mixed findings within DF for valence. Thus, it would be interesting to study and test the impact word categorisation will have for both valence and recall within DF.

5.2.3. Decay

Looking back at Experiments 1 and 2, they both used relatively short post-cue delays and this delay did not affect DF. In this experiment, a longer delay was used to allow more time for consolidation and forgetting processes to operate, as Nielson and Bryant (2005) found that having a delayed test enhanced memory. This was further supported by Wang (2015) who found enhanced consolidation for emotional stimuli over both a 25-minute delay and a 24-hour delay. This suggests that longer delays can benefit emotional items within consolidation, in comparison to the previous studies where the gaps were smaller. The short post-cue delays of

Experiments 1 and 2 did not affect DF, so it is important to test DF over longer delays. An enhanced consolidation of the TBR items may be observed with greater loss of TBF items. In addition to this, the longer delays allow further opportunities to determine whether different valences respond differently to DF over time, and assess whether the longer delay helps consolidation of emotional information. This may help to bridge the gap between active decay, valence and DF.

5.2.4. Individual differences and valence

Additionally, as the previous experiment (experiment 3a) explored sex differences, this study further explored the role of individual differences in DF, focusing on mood and emotional reactivity. Mood deals with feelings that are associated with cognitive states that influence behaviour and judgement (Amado-Boccara et al., 1993). Emotional reactivity is the response to an event that differs for everyone in terms of intensity, peak and baseline (Davidson, 1998).

Emotion can influence the way memories and information are recalled and generally interpreted (Schmidt, 2002). Some researchers suggest that positive mood will encourage a positive interpretation of surrounding events and thoughts (Bower, 1981; Rusting, 1998), whilst negative emotions have the opposite effect and evoke negative interpretations.

In terms of whether mood can affect what is recalled, Badli and Dzulkifli (2013) conducted a study in which one group of participants were induced with dysphoria (Dysphoric group) through a Velten Mood Induction Procedure (VMIP) and the other was not (Neutral Group). Participants were then shown clips that were humorous in nature, which also included words displayed on a white background. After all the clips were displayed, participants had to freely recall those words. Their

results indicated that humour impacted recall for those in a neutral mood and those in a dysphoric mood. This supports the idea that mood influences and biases recall. However, Badli and Dzulkifli also found that the neutral group had higher mood ratings than the dysphoric group. Thus, it can be seen that that mood can affect memory and could have an impact on the recall of different valences within the DF paradigm. Indeed, mood has typically been an uncontrolled variable in prior DF and valence studies.

In fact, the 'mood-congruent memory effect' shows how recall is reflective of individuals' mood at that moment (Blaney, 1986; Bower, 1981; Gotlib et al., 1996; Ingram, 1984; Matt, Vazquez & Campbell, 1992) - a finding that is prevalent in both clinical and non-clinical samples (Mayer et al.,1995). Mood congruity effects may be an outcome of increased attention to events that are mood related, which enhances encoding (Bower, 1981). This then aids retrieval as the item is represented or associated with a certain mood, making it easier to recall (Lewis & Critchley, 2003). This may potentially explain the differences in recall of positive and negative words within all three previous experiments, as mood of the participants may have played a role.

Further support comes from neuro-imaging studies exploring the amygdala. However, these are normally conducted with clinically depressed patients (Bradley, et al., 1995; Hamilton & Gotlib, 2008; Ramel et al., 2007) and there seems to be a lack of research dealing with mood congruent memory within non-clinically diagnosed individuals. However, mood congruent effects have been found in a variety of tasks, including the emotional go/no-go tasks (Blaney, 1986; Elliot et al., 2002), verbal tasks (Baker et al., 1997) and working memory tasks (Gray et al., 2002). Exploring both emotional reactivity and mood within the context of DF for

valence would enable a better understanding of individual differences and their influence on DF for all three valences. This may help to explain the fluctuation between positive and negative valence recall within the last three experiments, but mood and emotional reactivity may also have had an undetected role in prior DF studies.

5.2.5. The present study

In summary, it is clearly important to consider the word category (abstract and concrete), delay (delay and no delay), mood and emotional reactivity in regard to DF (Bjork, 1970) to understand the intentional forgetting of valence. The hypotheses tested in this experiment are as follows:

H_1) Participants will be able to recall more TBR words than TBF words.

H_2) Participants will be able to recall more emotional than neutral words.

H_3) Participants will be more likely to recall concrete than abstract words.

H_4) Participants will be more likely to recall words when there is no delay in comparison to when there is a delay.

H_5) Participants will be more likely to recall the emotional words when there is a delay in comparison to recalling the neutral words when there is a delay.

H_6) Participants will be more likely to recall TBF emotional words than TBF neutral words.

H_7) Participants will be more likely to recall TBF concrete words than TBF abstract words.

H_8) Participants scoring highly on 'emotional reactivity' and 'negative mood' will be able to recall more emotional TBF words.

5.3. Stimulus Development

5.3.1. Introduction

A pilot study was conducted in order to create an appropriate list of positive, negative and neutral concrete and abstract words (adapted from Paivio et al., 1968). These words were then used in Experiment 4.

5.3.1.1. Rating words

A tool was needed to allow participants to rate concrete and abstract words according to valence. The Self-Assessment Manikin ([SAM] Bradley & Lang, 1994) is designed to assess the dimensions of pleasure, dominance and arousal using images or a range of block characters. The scale itself has been used to assess emotional responses to a variety of situations and scenarios (Bradley,1994; Greenwald et al., 1989; Greenwald et al., 1993; McNeil & Brunetti, 1992; Miller, et al., 1987). However, in order to categorise the words appropriately according to concreteness, an adapted version of the SAM scale was used. The SAM scale was used to build the affective slider ([AS] Betella & Verschure, 2016), which helps participants in clarifying the characters and emotions in terms of pleasure and arousal. A strong correlation has been found between ratings from the AS and SAM (Lang et al.,1997), with AS being used extensively since development (Gabana et al., 2017; Wynes, 2018). Thus, with its reputation, the AS was used instead of SAM to allow participants to rate words for use in the following experiment.

5.3.1.2. Assessing mood

To assess mood, the PANAS scale (Watson et al.,1988) has been regarded as a good psychometric measure. Based on its history, it was used to assess the mood of participants to see whether mood state was related to the ratings of the words (e.g. a person in a negative mood may have been more likely to rate words as

negative). PANAS scores responses on two types of affect: positive (PA; 10 items) and negative (NA;10 items). High PA includes high energy, a concentration level that is high, and so on, whereas low PA indicates sadness or low energy. Moreover, a high NA would reflect feelings of contempt and nervousness whilst a low NA would indicate a calm and serene state (Villodas et al.,2011).

5.3.2. Method

5.3.2.1 Participants

Participants were recruited through the SONA system. Over 100 responses were collected but missing responses and incomplete data sets were removed. In total, 45 completed responses were used, from 36 females and 9 males (*M* age = 21.67, *SD* = 3.91).

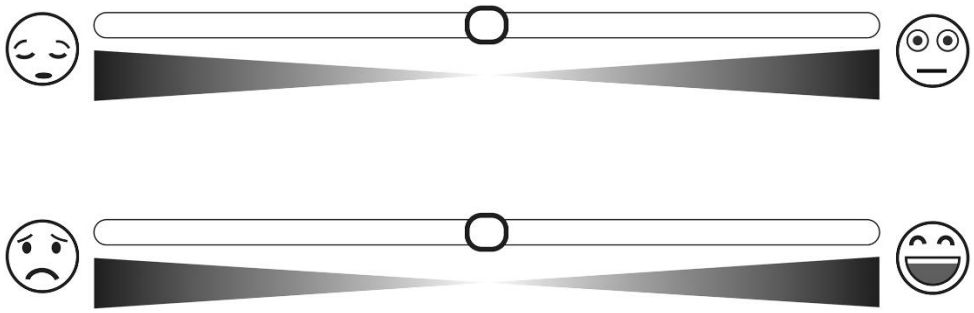
5.3.2.2 Materials

A web-based survey tool called 'Qualtrics' was used to create the questionnaire. This questionnaire included an information page, an informed consent page, a demographics questionnaire and a debrief page.

A total of 160 words were used, including a mixture of both abstract and concrete words from Paivio et al. (1968). An AS (Betella & Verschure, 2016) measuring stimuli on the domains of pleasure and arousal was used to rate each word, where the scale ranged from '0 to 100' (Figure 5.1) .To assess mood, PANAS was used (Watson, Clark & Tellegan, 1988) to rate how various adjectives (such as ‘interested’, ‘excited’, ‘hostile’, etc.) described a person’s mood. PANAS uses a scale ranging from '1- Very slightly or not at all’ to ‘5- extremely'. Good internal reliability has also been observed for PANAS (positive affect [α = .89] and negative affect [α =0.85]), making it an appropriate mood scale.

Figure 5.1.

A visual representation of the AS adapted from Betella and Verschure (2016).



Note. The scale shows the two domains of arousal (top row) and pleasure (bottom row) on a continuous scale.

5.3.2.3 Design

The study used a questionnaire design with participants completing all the questions and statements on the online platform. Ethical approval was also granted by the Ethics committee of the University of Wolverhampton (Appendix 15).

5.3.2.4. Procedure

Participants accessed the survey website 'Qualtrics' through any medium that had access to the internet. Participants firstly encountered an information page that explained the study and was followed up with an informed consent page which reiterated important aspects of the study. After fully consenting to the study, participants provided details about their sex and age on a demographics questionnaire. This was followed by the PANAS mood questionnaire. After finishing the PANAS, the actual survey began with the presentation of 160 words. The participant used the AS (Betella & Verschure, 2016) to rate each word on pleasure

and arousal. This was intended to distinguish concrete and abstract words according to valence (positive, negative or neutral). The participant responded by manually moving the slider with their mouse on the scale to indicate the pleasure and arousal level. At the end, participants were directed to a debrief page, where they were informed of the real reasons behind conducting the pilot study. This marked the end of the study.

5.3.3. Results and Discussion

Only the completed responses were analysed. The responses were then imported into a database where averages were calculated for arousal and pleasure. Words were then categorised within the domains of positive, neutral and negative. The scoring was based on thresholds, with 10-40 being negative, 50 being neutral and 60-100 being positive. The pleasure rating was taken as the valence rating within this scale. This was based on previous rating score styles that have been adapted within other affective databases. Mood was also analysed in regards to the word ratings as a correlation. However, all results were non-significant.*[2]

5.3.3.1. Word set

A total of 60 words from the pilot study were used to create a set of concrete and abstract words that varied in valence (positive, negative and neutral). The words were categorised according to pleasure and arousal, based on the mean ratings received for each word. Firstly, the mean length for each valence was matched,

[2] The pilot study assessed whether PANAS scores were related to the word ratings provided (e.g. participants in a negative affective state may be more likely to rate words as unpleasant) . The results, using Pearson's correlation, were non-significant: positive arousal scores and the PANAS scores (r[45] = .18, p= .250), positive pleasure scoring and the PANAS scores (r[45] = .16, p = .293), negative arousal scores and PANAS rating (r[45] = .14, p= .376) and the negative pleasure and PANAS rating (r[45] = -.06, p= .691). These results indicated that mood did not significantly correlate with ratings of arousal or pleasure.

which varied between 6 and 7 on average (Table 5.1. below). Additionally, the mean was also calculated for the level of pleasure, which was used to categorise words according to valence (as seen in Table 5.2 below). The words were also controlled on arousal (Table 5.3.) and frequency. These then formed the word list for Experiment 4 (Appendix 11).

Table 5.1.

Mean length for each word type and valence.

	Valence		
Condition	Positive	Neutral	Negative
TBR Abstract	6	6.8	7
TBR Concrete	6.4	6.6	6.8
TBF Abstract	6.8	6.8	7
TBF Concrete	6	7	7

Table 5.2.

Mean pleasure rating within both types of words and valence.

	Valence		
Condition	Positive	Neutral	Negative
TBR Abstract	76.91	51.03	13.90
TBR Concrete	72.63	46.51	15.44
TBF Abstract	76.52	50.69	13.60
TBF Concrete	73.60	45.55	15.67

Table 5.3.

Mean arousal within both types of words and valence.

	Valence		
Condition	Positive	Neutral	Negative
TBR Abstract	59.02	41.45	44.18
TBR Concrete	51.19	38.85	45.36
TBF Abstract	60.72	44.52	43.33
TBF Concrete	55.13	35.88	41.14

5.4. Method

5.4.1. Participants

Psychology students from the University of Wolverhampton were recruited through opportunity sampling. This experiment was conducted within two separate practicals as part of an introductory research methods module. The study was carried out on 158 first-year psychology undergraduate students with 139 females and 19 males (*M* age = 23.94, *SD* = 8.19). Based on the circumstances and the timing of the practicals, participants were either a part of the delay group (73 participants) or the no-delay group (85 participants).

5.4.2. Materials

Paper materials included an information sheet, consent form and demographic questionnaire, a word recall sheet and a debrief sheet as mentioned in previous chapters. There were also two further questionnaires: PANAS (Watson et al., 1988, as used in the word rating study) and the PERS (Becerra & Campitelli, 2013) questionnaire. These assessed mood and emotional reactivity, respectively.

The PERS scale (Becerra & Campitelli, 2013) includes 30 different statements, e.g. ‘I tend to get happy very easily’. Participants then choose a response, from '1 - Very unlike me’ to ‘5 - Very like me', that best describes how that statement applies to them. The internal reliability was checked ([Becerra et al., 2017] and was acceptable: negative reactivity scale [Cronbach’s α = .94], positive reactivity scale [α = .93]. Subscale level: negative-activation [α = .86], negative-intensity [α = .87], negative-duration [α = .85], positive-activation [α = .81], positive-intensity [α = .89], positive-duration [α = .81]). The PANAS scale (Watson et al., 1988) was also completed as described in the pilot study.

5.4.3. Design

The study used a mixed experimental design. Four IVs were included, where three were repeated measures: valence (positive, negative and neutral), cue (TBR and TBF), and type of word (abstract or concrete). The last IV was an independent groups variable: the length of the delay (delay or no delay). The DV was the number of words that were correctly recalled. Additionally, mood and emotional reactivity were used as predictors against the number of words recalled and they were analysed through correlations. Ethical approval was also granted by the Ethics committee of the University of Wolverhampton (Appendix 15).

5.4.4. Procedure

The experiment was set up in a classroom as part of a research methods practical. Participants were seated at a desk, facing a large board. Each participant was then handed an information sheet which provided information about the experiment. After reading this, participants were told to fill in a consent form which was used to reiterate important information to the participant. Once this sheet had been signed and full consent had been given, it was collected by the researcher. Next, participants were given generic verbal instructions on what they were going to do.

A demographics questionnaire was provided and followed by the completion of two questionnaires: the PANAS (Watson et al., 1988) and the PERS (Becerra & Campitelli, 2013). Once the participants had completed both questionnaires, they were then told to set the sheets aside and concentrate on the next phase of the experiment.

A total of 60 words were presented on the screen in a random order, individually, for 1.5 s each. Each word was followed by a cue (either 'TBR' or 'TBF'). The cue was also shown for 1.5 s and used to prompt the individual to remember or forget the word. After all the words had been presented, participants were asked to recall all the words they had been shown regardless of the associated instruction. Depending on the condition, participants had to recall these words immediately or after a 10-minute delay. Both groups of participants had 5 minutes to write down the words manually on a recall sheet. Once the five minutes elapsed, all the materials were collected by the researcher. A debrief sheet was then handed to the participants, which was used to explain the intent of the study.

5.5. Results

Means (*M*) and standard deviations (*SD*) for correctly recalled words were calculated, following the approach of Experiment 1. For the no delay condition (Table 5.4.) there was generally better recall for the concrete words rather than the abstract words. There was a DF effect, with participants recalling more TBR words than TBF words. As for valence and the type of words being recalled, the concrete and abstract positive words were recalled more than negative and neutral words when they were associated with the TBR cue. For the TBF abstract words, there was a similar level of recall for the negative (*M* = .07, *SD* = .11) and neutral words (*M* = .07, *SD* = .10). However, they were both recalled more than the positive words (*M* = .05, *SD* = .10). When there was a TBF cue and concrete words, there was better recall for the positive words (*M* = .13, *SD* = .13) than negative words (*M* = .10, *SD* = .17) and neutral words (*M* = .07, *SD* = .12), with the latter words being recalled the least.

Table 5.4.

Mean (and standard deviation) proportion of correct recall in the no delay condition according to cue, valence and word type.

	Concrete			Abstract		
	Positive	Neutral	Negative	Positive	Neutral	Negative
TBR	.32 (.25)	.23 (.22)	.28 (.21)	.25 (.22)	.20 (.18)	.22 (.18)
TBF	.13 (.13)	.07 (.12)	.10 (.17)	.05 (.10)	.07 (.10)	.07 (.11)

Within the delay condition (Table 5.5), there was generally better recall for the concrete words than the abstract words for each valence and cue, but this was not the case for TBF neutral and negative words, where abstract words were recalled more than concrete words. There was a consistent DF effect, with participants recalling more TBR words than TBF words. As for valence, positive words (*M* = .21, *SD* = .19), were recalled more than negative (*M* = .15, *SD* =.17) and neutral (*M* = .13, *SD* = .17) words when they were associated with the TBR cue and were abstract. Yet when the positive words (*M* = .22, *SD* = .22) were concrete and associated with the TBR cue, there was a less distinct positivity bias, as they were recalled less than neutral words (*M* = .23, *SD* = .20). For the TBF cue, abstract positive (*M* = .05, *SD* =.10) and neutral words (*M* = .05, *SD* = .10) had a similar level of recall. However, they were both recalled less than the negative words (*M* = .08, *SD* =.13). When there was a TBF cue and concrete words, recall of the positive (*M* = .06, *SD* = .13) and negative words (*M* = .06, *SD* = .12) was similar, with neutral (*M* = .03, *SD* = .07) words being recalled the least.

Table 5.5.

Mean (and standard deviation) proportion of correct recall in the delay (10-min) condition according to cue, valence and word type.

	Concrete			Abstract		
	Positive	Neutral	Negative	Positive	Neutral	Negative
TBR	.22 (.22)	.23 (.20)	.20 (.23)	.21 (.19)	.13 (.17)	15 (.17)
TBF	.06 (.13)	03 (.07)	.06 (.12)	.05 (.10)	.05 (.10)	.08 (.13)

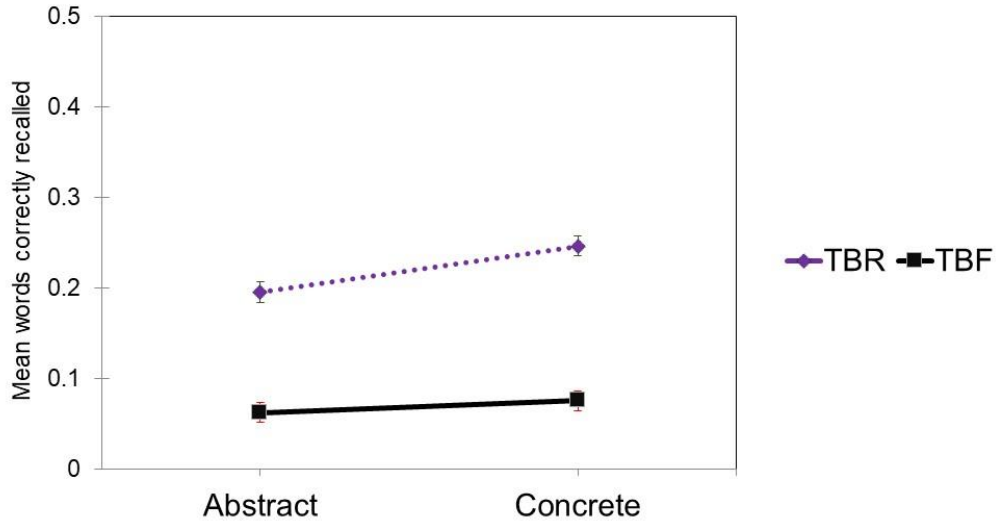
A mixed ANOVA was conducted on the four IVs: valence (positive, negative and neutral), cue (TBR and TBF), type of word (abstract or concrete) and time (delay or no delay). The DV was the proportion of correctly recalled words (additionally, where the sphericity assumption was not met, the Greenhouse-Geisser correction was applied). The ANOVA showed a significant effect for cue (F [1, 156] = 300.10, p < .001, η_p^2 = .66) and TBR words (M = .22) were more likely to be recalled than TBF words (M = .07).

Valence was also significant (F [2,312] = 9.13, p < .001, η_p^2 = .06) and a Šidák post-hoc test was used to explore this effect. The results indicated a significant difference in recall between the positive and neutral words (p < .001) and a non-significant difference between the positive and the negative words (p = .109). The test also found a non-significant difference between neutral and negative word recall (p = .051), however, this was just above the threshold of significance. In terms of the type of word (concrete or abstract), concrete words (M = .16) were recalled

significantly better than abstract words (M = .13; F[1,156] = 19.47, p < .001, η_p^2 = .11). The final main effect – delay length– was also significant (F[1,156] = 14.08, p < .001, η_p^2 = .08), with better recall for the no delay (M = .17) than delay condition (M = .12).

Figure 5.2.

Representation of the interaction between the concreteness and the cue type on the proportion of recalled words.



In terms of the interactions, only a few were significant. Firstly, cue and type (F[1,156] = 5.74, p = .018, η_p^2 = .04) interacted. TBR concrete word recall exceeded TBR abstract word recall, but there was no concreteness effect for TBF words (see Figure 5.2.).

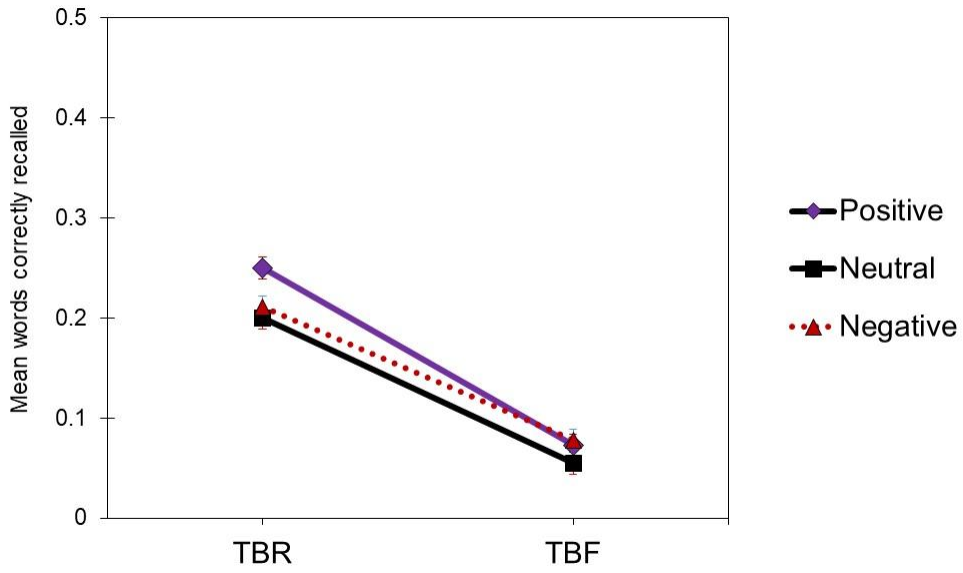
Paired-sample t-tests were used to look at this interaction in more depth, applying the Holm-Šidák correction. The test showed a significant difference (t[157] = 4.00, p <.001, r = .30) between the abstract-TBR words when compared to the

concrete-TBR words. Comparing the abstract-TBF words and concrete-TBF words showed a non-significant difference (*t* [157] = 1.76, *p* = .081, *r* = .40).

Additionally, the cue and valence interaction was also significant (*F* [2,312] = 4.03, *p* = .019, η_p^2 = .03), with TBR positive words being recalled better than negative and neutral words. The difference between positive and negative word recall was less prevalent for the TBF cue, and the general DF effect remained, with recall declining following the TBF cue (as seen in Figure 5.3.).

Figure 5.3.

Representation of the interaction between word valence and cue on the proportion of recalled words with 95% confidence intervals.



To explore this interaction, a one-way ANOVA compared valences within each cue. A significant effect was found for both the TBR cue (*F*[2,314] = 8.06, *p* < .001) and the TBF cue (*F*[2,314] = 3.39, *p* = .035). Paired-sample *t*-tests then further assessed these effects. The tests showed that there was a non-significant

difference (t[157] = 1.01, p = .312, r =.10) when comparing the TBR negative words (M = .21, SD = .15) and TBR neutral words (M = .20, SD = .15). However, a significant effect was found for the TBR positive words (M = .25, SD = .17) when compared to both the TBR negative words (t[157] = 3.63, p =.002, r = .28) and the TBR neutral words (t[157] = 3.63, p = .002, r =.28). For the TBF cue, a significant difference was found (t[157] = 2.60, p = 0.04, r =.02) between the negative words (M = .08, SD = .09) and the neutral words (M = .06, SD = .07). Comparing the negative words with the positive words (M = .07, SD = .09) revealed a non-significant difference (t[157] = .25, p = .801, r =.01). The last comparison between neutral words and positive words was also non-significant (t[157] = 2.29, p = 0.07, r = .17).

The remaining interactions were non-significant: cue and delay (F[1,156] = 3.60, p = .060, η_p^2 = .02), valence and delay (F[2,312] = .80, p = .451, η_p^2 = .01), cue, type and delay (F[1,156] = 2.89, p = .091, η_p^2 = .02), cue, valence and delay (F[2,312] = 1.12, p = .327, η_p^2 = .01), type and valence (F[2,312] = .21, p = .809, η_p^2 = .001), type, valence and delay (F[2,312] = 2.53, p = .082, η_p^2 = .02), cue, type and valence (F[2,312] = 3.04, p = .052, η_p^2 = .02) and finally cue, type, valence and delay (F[2,312] = 1.08, p = .341, η_p^2 = .01).

A DF score was then computed (see Table 5.6) and a repeated measures ANOVA was conducted on this DF score, comparing valences. A significant effect was found (F[2, 314] = 3.67, p = .027, η_p^2 = .02). Follow-up post-hoc Šidák tests found a non-significant difference between positive and negative words (p = 0.07), neutral and negative words (p = .909) and the positive and neutral words (p= 1.00). These results show an overall effect, however they appear subtle and are driven mostly by a difference between positive and negative words.

Table 5.6.

Mean and standard deviation for the computed DF scores within each of the valences.

Valence	*M*	*SD*
Positive	.18	.17
Neutral	.15	.15
Negative	.14	.17

Finally, Cowan et al.'s (2001) statistic was used to quantify the cue-driven forgetting rate. Forgetting differed amongst each valence, ranging from 57% - 74% (see Table 5.7). A one-way repeated measures ANOVA was conducted on this forgetting score and an effect was found ($F[2, 230] = 213.84$, $p < 0.01$, $\eta_p^2 = .65$). Post-hoc Šidák tests found significant differences between the positive and negative words ($p < 0.01$) and the positive and neutral words ($p < 0.01$), but a non-significant difference between the neutral and negative words ($p = 0.07$). This indicates that DF is greater for neutral words, followed by the positive words and then negative words.

Table 5.7.

Mean and standard deviation for the computed Cowan et al. (2001) scores for each valence.

Valence	*M*	*SD*
Positive	.64	.58
Neutral	.74	.37
Negative	.57	.69

5.5.1. Assessing individual differences through correlations

Lastly, Pearson's correlations were conducted to examine relationships between the PANAS scale, the PERTH scale and recall for each cue/ valence combination (see Table 5.8). This was intended to explore individual differences and DF. It was found that most correlations were non-significant, but there was a negative correlation between TBR neutral recall and positive emotional reactivity (r[158] = -.18, p = .022). Additionally, positive correlations between TBF negative recall and negative emotional reactivity (r[158] = .18, p = .026) and between TBR negative recall and negative reactivity (r[158] = .17, p = .030) were found. Lastly, relationships between TBF neutral recall and negative emotional reactivity (r[158] = .16, p = .050) and TBF neutral recall and positive emotional reactivity (r[158] = .20, p = .011) were also found.

Table 5.8.

Correlation matrix showing relationships between the PANAS scale, the PERTH scale and recall for each cue/valence condition.

Measures	1	2	3	4	5	6	7	8	9
1. Positive Affect	-								
2. Negative Affect	-.010	-							
3.Positive Reactivity	-.392*	-.330*	-						
4. Negative Reactivity	-.288*	.312*	-.267*	-					
5. TBR Positive	-.140	.018	-.075	.033	-				
6. TBF Positive	-.074	-014	-.098	.107	.258*	-			
7. TBR Neutral	-.171*	.050	-.182*	.114	.340*	.236*	-		
8. TBF Neutral	-.023	.040	-.203*	.156*	-.006	.259*	.086	-	
9. TBR Negative	.002	.149	-.080	.172*	.404*	.352*	.446*	.115	-
10.TBF Negative	-.137	.100	-.110	.177*	.250*	.084	.189*	.287*	.122

Key= ***** $p<0.05$; Positive Affect (PANAS) = Positive Mood; Negative Affect (PANAS) = Negative mood; Positive Reactivity= positive emotional reactivity (PERS questionnaire); Negative Reactivity = negative emotional reactivity (PERS questionnaire). Additionally, interpretation of these results should be done with caution due to the large number of comparisons.

The correlation between the DF score for each valence, PANAS and emotional reactivity were non-significant (see Table 5.9).

Table 5.9.

Correlation matrix on the DF score and emotional reactivity.

Measures	1	2	3	4	5
1. Positive Reactivity	-				
2. Negative Reactivity	-.267*	-			
3.DF Positive	.022	.024	-		
4. DF Neutral	.066	-.027	.265*	-	
5. DF Negative	-.009	.053	-.296*	-.075	-

Key= ***** p<0.05; Positive Affect (PANAS) = Positive Mood; Negative Affect (PANAS) = Negative mood; Positive Reactivity= positive emotional reactivity (PERS questionnaire); Negative Reactivity = negative emotional reactivity (PERS questionnaire). Additionally, interpretation of these results should be done with caution due to the large number of comparisons.

5.6. Discussion

5.6.1. DF

The results from this experiment again found DF, where participants remembered more 'TBR' words than 'TBF' words. This coincides with the previous experiments (Chapters 2-4) and shows that information can be intentionally forgotten when there is an appropriate cue to do so.

Emotional words were recalled better than neutral words, which is consistent with the findings of the three previous experiments. However, the positive words

were not recalled more than the negative words (reflecting Chapter 3 & 4). Of most importance was the interaction between cue and valence, which was significant and showed that the cue influenced recall differently for each valence. Emotional 'TBR' words were recalled more than 'TBF' emotional words, but TBR positive words were recalled more than both TBR negative and neutral words, suggesting a form of positivity bias within the TBR cue, similar to Experiment 1. Negative words were also remembered better than neutral words. To some extent this was mirrored with the 'TBF' cue, where negative words were recalled better than neutral words, suggesting neutral words are more prone to DF. This was also supported by the Cowan statistic. However, there was no significant difference between TBF positive and TBF negative recall. That both TBF positive and TBF negative words did not differ in recall may suggest that both valences are susceptible to being intentionally forgotten. However, the DF score also suggested a trend towards greater forgetting of positive words, as well as reduced DF for the negative words.

5.6.2. Concreteness, valence and recall

Results showed that concrete words were recalled better than abstract words, demonstrating a concreteness effect (de Groot et al., 1994; Schwanenflugel et al., 1988; Holmes & Langford, 1976; Paivio, 1991). However, this was only significant for the TBR cue. The valence of the stimuli within the abstract and concrete dimensions also manipulated memory at the time of recall (Vigliocco et al., 2013). Specifically, abstract and concrete positive words were recalled better than neutral or negative words. This suggests that positive imageability seems to be remembered more, but is still susceptible to DF. Additionally, concrete words were susceptible to DF and

regardless of the general concreteness effect uncovered, there was still robust DF. Concreteness therefore does not influence the recall of valence within DF.

5.6.3. The impact of the delay

Experiencing a delay after the word set generally lowered recall, supporting Experiment 1. Yet the delay did not affect DF itself, suggesting that DF is not linked to the passage of time. Rather, the DF effect may happen rapidly, as in previous experiments. The passage of time also did not enhance the valence property or help diminish its' recall within DF. Thus, it is of importance to understand that unlike other studies, having an increased time between recall does not enhance consolidation for emotional stimuli. However, this may also be due to the delay being much shorter than studies such as Wang (2015), who opted for 24 hours.

5.6.4. The role of individual differences

Lastly, individual differences such as mood and emotional reactivity may not be related to DF. While there were a few significant correlations between recall and emotional reactivity, there was no significant correlation between the DF effect, mood and emotional reactivity.

Firstly, mood was not associated with recall of the emotional words as opposed to findings reported by Schmidt (2002). However, there was a significant relationship between positive mood and recall of the TBR neutral words. This suggests that positive mood may modulate how these neutral words are perceived. Furthermore, the TBR and TBF neutral words shared a relationship with positive emotional reactivity. This would suggest that neutral words are easier to recall in people experiencing positive emotions. However, TBR and TBF positive word recall

was not related to mood or emotional reactivity. This may signify that the threshold and perception of emotions is an important factor to consider.

A relationship was also found between TBF neutral word recall and negative emotional reactivity, yet this was a negative relationship. This may indicate that an individual with high negative emotional reactivity perceives neutral words in a negative manner. A correlation between the recall of both TBR and TBF negative words with negative emotional reactivity was also found, indicating that these individuals may react more to negative stimuli.

When the DF score was explored in relation to emotional reactivity, results were non-significant and suggested that, overall, reactivity may correlate with recall of certain stimuli, but not intentional forgetting. It could also be argued that emotional reactivity may be regulated by individuals with more control, as participants can handle pleasant and unpleasant stimuli that are high in intensity. Thus, with greater control over emotional reactivity, participants are able to control their emotional responses towards different valences (Gross, 2014).

Overall though, the DF effect seemed to be prominent regardless of mood or emotional reactivity, so these individual differences may not be as strong predictors as previously thought (Wheeler et al., 1993).

5.6.5. Considerations and conclusions

DF was found and concrete words were remembered better than abstract words. The Cowan statistic also indicated that the neutral words underwent greater DF in comparison to the emotional stimuli, followed by the positive and then negative words. Yet regardless of any other manipulations, positive words were also better recalled than negative or neutral words within the TBR cue, whereas within the TBF

cue the positive words did not have the same impact. Results also did not support the traditional mood and emotional reactivity influence. One potential problem is that categorising words within three broad valences may lead to more specific effects being missed or overlooked. As such, there is need for more clarification on emotional stimuli and why there is a fluctuation between cue and valence (see Chapters 2-4). Thus, it would be ideal to look at specific categories rather than broad valences, which would allow a better understanding as to what exactly individuals find easier to intentionally forget.

In conclusion, DF is shown for all valence types, even when words are high in concreteness, and mood and emotional reactivity did not correlate with the DF effect.

Chapter 6.

Combined ANOVA

6.1. Introduction

Based on the inconsistencies in Experiments 1-3a and 4, especially concerning the interaction between cue and valence, assessing the combined data may be helpful. While the effect of cue was always consistent in the free recall experiments (TBR > TBF), the specific effect of valence was inconsistent, and the cue x valence interaction varied from study to study (see Appendix 13). There was also variability between the three different measures of DF. This chapter presents an overall analysis for all free recall experiments (1-3a & 4), assessing the cue and valence interaction, Cowan scores and DF scores.

A pooled ANOVA allows subtle effects to be explored using a very large sample, which may identify underlying effects that some experiments may have missed.

6.1.1 Rationale

Based on the four free recall experiments, a pooled ANOVA was conducted to determine whether there is an underlying cue x valence interaction. In addition to this, analyses of the pooled DF and Cowan statistics were performed.

6.2. ANOVA

Data from the first four free recall experiments were collated and analysed using a 2 (Cue: TBR and TBF) x 3 (Valence: positive, neutral and negative) ANOVA. Cue was significant (F[1, 299] = 431.10, p < .001, η_p^2 = .59), with higher recall of TBR words (M = .25) than TBF words (M = .09).

For valence, the effect was also significant (F[2, 598] = 43.75, p < .001, η_p^2 = .13) and post-hoc Šidák tests confirmed there were significant differences between each valence type. Positive words (M = .20) were recalled more than neutral words (M = .14, p < .001) and negative words (M = .18, p < 0.05). A significant difference between negative and neutral word recall was also found (p < .001), with the recall of negative words being higher than neutral.

There was also a significant interaction (F [2, 598] = 3.73, p = .024, η_p^2 = .01). Based on this interaction, a paired-sample t-test was conducted to compare both cues (TBR and TBF) and each valence (positive, neutral and negative). There was a significant difference for the TBR cue, with the positive words (M = .27) being recalled more than the neutral words (M =.20; t[302] = 6.87, p < 0.01; r = 0.37) and the negative words (M = .24; t[302] = 3.71, p < 0.01, r = 0.20). Additionally, negative words were more likely to be recalled than neutral words (t[302] = 3.52, p < 0.01; r = 0.20).

As for the TBF cue, positive words (M = .09) were recalled more than neutral words (M = .06; t[302]= 5.28, p < 0.01, r = 0.28), as were negative words (M =.09;t[302] = 4.49, p < 0.01, r = 0.24). However, there was a non-significant difference between the positive and negative words (t[302] = .59, p = 0.56, r = .00).

Next, a DF score was computed by subtracting mean TBF from mean TBR (see Table 6.1.). A repeated measures ANOVA was conducted on the DF scores, which showed significant results (F[2, 604] = 5.56, p = .004, η_p^2 = .02). Šidák tests confirmed a significant difference (p = .006) between positive (M = .18) and neutral words (M = .15), where positive words showed higher DF. However, there was a non-significant difference (p = 0.30) between the positive and negative words (M = .15) and the negative and neutral words (p = .993). This seems to indicate greater

DF for positive than neutral stimuli, which can be accounted for by the TBR bias for positive stimuli.

Table 6.1.

Mean and standard deviation for the computed DF scores within each of the valences.

Valence	M	SD
Positive	.18	.27
Neutral	.15	.21
Negative	.15	.19

Lastly, Cowan et al.'s (2001) statistic was used to quantify the cue-driven forgetting rate. When applying this statistic to the current data, possible forgetting differed amongst each valence, ranging from 56% to 69% (see Table 6.2.). A one-way repeated measures ANOVA found significant results for the three valences (F[2, 454] = 4.69, p= .010, η_p^2= .02), and Šidák tests confirmed reduced forgetting (p = .025) for negative words against the neutral words, and the same effect when comparing positive and neutral words (p = .012). There was no significant difference (p = .950) between the positive words and the negative words.

Table 6.2.

Mean and standard deviation for the computed Cowan scores within each of the Valences.

Category	M	SD
Positive	.58	.59
Neutral	.69	.46
Negative	.56	.60

6.3. Discussion

In relation to the above ANOVA and previous experiments, there were several key findings: a) cue is highly important and strong DF was observed; b) valence impacts recall with a strong emotionality bias; c) the cue and valence interaction suggests a positivity bias within the TBR cue, but not TBF. In fact, based on the significant but weak interaction between cue and valence, the instructional cue was robust and DF was seen for every valence.

The pooled ANOVA helps indicate why the interaction was not always present in individual experiments as it was a small effect and difficult to find without a large sample (Experiments 1-4; See Appendix 13). For an individual experiment, this interaction may not always be significant, but when the data are pooled together the significant results indicate that cue and valence influence each other at the time of recall. Additionally, the pooling of data further cements the idea that the positivity bias is more prominent within the TBR cue, but within the TBF cue positive and negative words are recalled at a similar rate.

In relation to the Cowan and DF scores, the Cowan statistic showed that positive and negative words were forgotten at a similar level, and the neutral words were forgotten the most. However, when compared to the DF scores, the positive words showed the most substantial forgetting. This may be due to the higher recall of the positive TBR words. Each valence type was subjected to forgetting, with positive words being recalled more within TBR (positivity bias) as shown in the interaction in the ANOVA (see Chapter 8 for a further discussion).

Chapter 7.

Experiment 5: The role of categorisation on DF

7.1. Abstract

Within the research conducted in this thesis so far, each study has explored DF in relation to valence. This experiment intended to be more specific by exploring specific categories of words. This may help to understand the role of valence as specific categories may exert a stronger effect in comparison to general valence. Thus, in this last experiment, 57 words from four specific categories (household, body, sexual and abuse) were investigated instead of broader valence. The study once again used the item-method, with participants viewing words one by one on a screen, followed by free recall. However, this time the delay was removed due to previous non-significant interactions with DF (see Chapters 1-5). Results showed a strong DF effect, but category type was also influential, with sexual words being recalled more than the other categories. However, there was no interaction, suggesting another consistent DF effect.

7.2. Introduction

7.2.1. Categorical groups and valence

The basic principle of categorisation is that individuals use similar structures and properties of stimuli to group them or classify them in relation to each other (Rosch, 1978). Experiments 1-4 showed better recall of emotional words from broad "positive" and "negative" categories. Interestingly, researchers have argued that individuals are most likely to recall emotional stimuli that are evocative (Colombel, 2000; Doerksen & Shimamura, 2001; Kensinger et al., 2002). This has been

reported for both images (Blake et al., 2001) and words (Doerksen & Shimamura, 2001; Ferre et al., 2015).

Stimulus categorisation and semantic relatedness is an important factor and influences what is remembered (see Chubala et al., 2019; Hunt et al., 2015; Kamp et al., 2015). In relation to valence, Semantic relatedness may be important as emotional stimuli are all connected and more closely related than neutral stimuli (Talmi & Moscovitch, 2004). The close relationship between emotional stimuli strengthens recall (Mandler, 1967; Puff, 1970; Talmi & Moscovitch, 2004, Tulving & Pearlstone, 1966), but the recall of emotional material may also be influenced by imageability. Smythe and Paivio (1968) argued that participants are more likely to recall word pairs that reflect high imagery, even if the pairs are low in similarity. Thus, it can be argued that categorisation per se does not influence memory, rather, it is the vividness in imagery that categorisation provides. In terms of valence, the imagery emotional words represent may be much stronger than that associated with neutral words (Altarriba et al., 1999; Bauer et al., 2017; Bowen et al., 2018). This may also translate to the results of DF, where certain categories may be more resistant to DF than other categories. So far, however, this thesis has only tested broad categories of valence (positive, neutral and negative) and has not yet looked deeper into sub-categories within each valence.

To explore the role of categorisation on emotional memory, Talmi and Moscovitch (2004) had participants view six lists, each containing 28 words. Two lists were emotional, two were neutral with categories and two were neutral lists without categories. Participants had words presented to them individually on a screen and were asked to look at the words and read them aloud. Distractor tasks were also added within intervals lasting 40 to 45 minutes. A three-minute free recall

task was then initiated. Talmi and Moscovitch (2004) found that list type did indeed have an impact, with emotional and categorised neutral words being recalled better than non-categorised neutral words. Furthermore, recall of emotional words did not exceed categorised neutral words.

Other studies have looked at this issue in more depth, such as Madan et al. (2017), who researched categorisation in regards to taboo words. Their participants viewed four 40-word lists. This consisted of 1) taboo words that were highly arousing, 2) moderately arousing positive words, 3) moderately arousing negative words, and 4) neutral words. Participants underwent three tasks, including free recall, affective ratings and a lexical decision task. Results indicated that both emotional and non-emotional words contributed to recall. When Madan et al. (2017) compared recall for each category, they found that recall was driven by the emotional properties of the words. It was also found that taboo specific words (words that have a shock or offensiveness value) worked independently from the other stimulus properties. This suggests that categories, especially for taboo subjects that capture attention, drive the difference between emotional and non-emotional words. Conversely, if these words are segregated or removed from the equation, differences between emotional and non-emotional words are minimised. In summary, specific categories play an important role within word recall.

7.2.3. Categorisation, valence and DF

Based on the above literature, recall of emotionally valenced stimuli is impacted by categorisation. Some studies have also shown that categories can influence DF findings, with certain categories being less susceptible to intentional forgetting. This was reported by Marchewka et al. (2016) who categorised images

according to basic emotion, with participants being shown images depicting fear, disgust, sadness or neutral events. The study used the item-method of DF and a recognition task. Results found a traditional DF effect, with TBR images being recognised better than TBF, in line with prior work. Additionally, Marchewka et al. found higher hit rates for disgust-related images followed by fear and sadness, then neutral, suggesting that DF is robust. However, it also shows that there are underlying properties that influence retrieval. Yet due to the lack of research in this area on DF, there is a lot more to understand concerning DF for emotional stimuli and whether moving beyond broader valence categories (e.g. positive, negative and neutral) can lead to a better understanding of why there are discrepancies within DF for emotional stimuli.

7.2.4. The present study

In summary, semantic relatedness and categorisation within memory studies is important, yet within the field of DF there is scarce literature, with the exception of Marchewka et al. (2016). Thus, based on what has been found before, it is important that stimuli be categorised within more specific domains and, as the research above has identified, these should include distinct categories that envelop distinct concepts (sexual, taboo, etc). Thus, this study will test DF within categories (abuse, sexual, body and household objects), assessing whether emotional words within certain domains affects recall. Two categories of abuse and sexual words were used along with two control categories (body and household).

The following hypotheses were tested:

H_1) Participants will recall more TBR words than TBF words.

H_2) Participants will be more likely to recall words from the emotion categories ('sexual' and 'abuse') than the neutral categories (‘body’ and 'household objects’).

H_3) Participants will recall more TBF words from the 'emotion' categories than the 'neutral ' categories.

7.3. Method

7.3.1. Participants

On the basis of a G*Power analysis and prior cue x valence interactions, the study was carried out on 50 Psychology undergraduate students from the University of Wolverhampton (39 females and 11 males [*M* age= 26.16, *SD* = 11.17]). Recruitment once again took place through the online portal SONA and invitations.

7.3.2. Materials

The paper materials used here were similar to the previous experiments, with an information sheet, consent form, demographics questionnaire, recall sheet and a debrief sheet.

For the actual experiment, 57 words were selected from the ANEW list (Bradley & Lang, 1999). They were equally divided amongst the four categories: abuse/ threat, sexual, household objects and body, i.e. 'insult', 'virgin', 'pillow' and 'finger', respectively. Importantly, all words were balanced according to frequency, word length and cue (TBR and TBF). Each list was created to have a fair representation of each variable. The mean length of the words was then calculated across all the variants (6.0). These words were shown to participants on a standard computer screen (19" HANNS.G HP191) using 'SuperLab' 5 software.

7.3.3. Design

The study used a repeated measures design. Within this experiment there were two IVs, including word category, which had four levels (sexual, abuse, household objects and body-related). The second IV was the cue (TBR and TBF). The DV was the number of words that were correctly recalled. Ethical approval was also granted by the Ethics committee of the University of Wolverhampton (Appendix 15).

7.3.4. Procedure

Participants were seated within a cubicle in front of a computer. Depending on the size of the lab room, participants were either tested alone or with another participant who sat at the opposite end of the room at a different computer. At this point instructions and basic information were given regarding the experiment. It was advised that any form of communication had to be avoided when there were two participants present. It was also ensured that participants sat at opposite ends of the room to avoid any collusion. Information sheets were handed to the participant and they all gave their full informed consent to take part. After this, participants provided details on their age and sex. Once these sheets were completed, they were handed to the researcher for secure storage. Verbal instructions for the next phase were then given.

A total of 57 words were presented on the screen individually for 1.5 s each. After each word, a cue (either TBR or TBF) was also presented for 1.5 s. The cue prompted the individual to either remember or forget the word. Once all the words had been presented, participants were asked to recall all words regardless of the

associated cue. The recall task was completed within a time span of five minutes, using a recall sheet. After five minutes had elapsed, the recall sheet was collected by the researcher and the participant was given a debrief sheet that explained the true nature of the study.

7.4. Results

Means (*M*) and standard deviations (*SD*) for recalled words were calculated in the usual manner, and there was generally better recall for the sexual words for each cue in comparison to all the other types (see Table 7.1). Yet regardless of the type of word, there was still a traditional DF effect.

Table 7.1.

Mean (and SD) proportion of correct recall for both cue and word category.

Category	TBR	TBF
Sexual	.39 (.21)	.23 (.26)
Abuse	.30 (.15)	.16 (.16)
Household Objects	.26 (.17)	.10 (.13)
Body	.28 (.20)	.10 (.16)

A repeated measures ANOVA was conducted (if the sphericity assumption was not met, the Greenhouse-Geisser correction was applied), and this showed a significant effect of cue ($F[1, 49] = 63.28$, $p < .001$, $\eta_p^2 = .56$), suggesting a DF effect.

TBR words (*M* = .31) were more likely to be recalled than TBF words (*M* = .15). Additionally, category type was also significant ($F[3,147] = 14.15$, $p < .001$, $\eta_p^2 = .22$), where 'sexual words' were recalled most (*M* = .31), followed by 'abuse' (*M* = .23), 'body' (*M* = .19) and ‘household objects’ (*M* = .18). Post-hoc Šidák tests were conducted on the category word type and this showed that sexual words were recalled more than abuse related words ($p < 0.01$), and abuse words more than household objects ($p = .038$). Sexually categorised words were also more likely to be recalled than the household objects ($p < 0.01$) and the body related words ($p < 0.01$). The Šidák test showed non-significant differences between the categories of abuse and body ($p = .360$) and household objects and body ($p = .999$).

The interaction between cue and type was non-significant ($F[3,147] = .18$, $p = .909$, $\eta_p^2 = .004$), suggesting similar DF effects for all categories at the time of recall.

Table 7.2.

Mean and standard deviation for the computed DF scores within each of the categories.

Category	*M*	*SD*
Sexual	.16	.27
Abuse	.14	.21
Household Objects	.15	.19
Body	.17	.24

Next, a DF score was computed by subtracting mean TBF from mean TBR (see Table 7.2). A repeated measures ANOVA was conducted based on the DF score and category type, but no significant effect was found (F[3, 147] = .18, p = .909, η_p^2 = .004).

Lastly, the adapted method from Cowan et al. (2001) was used to quantify the cue-driven forgetting rate, based on the amount of information that could be forgotten. Based on this method, possible forgetting differed amongst each category, ranging from 29%-68% (see Table 7.3). A one-way repeated measures ANOVA was conducted and significant differences were found (F[3, 96] = 3.38, p = .021, η_p^2 = .10). Post-hoc Šidák tests found a significant difference between sexual words and body related words (p = .006), with sexual words being forgotten less (M = .29) than body related words (M = .68). No other comparisons were significant: abuse and sexual (p= .959); abuse and household related (p = .791); abuse and body related (p = .217); sexual and house related (p= .299); and household objects and body related (p = .954).

Table 7.3.

Mean and standard deviation for the computed Cowan et al. (2001) scores within each of the categories.

Category	*M*	*SD*
Sexual	.29	.62
Abuse	.42	.66
Household Objects	.57	.51
Body	.68	.48

7.5. Discussion

7.5.1. DF

Following Chapters 2-5, the results from this experiment found a strong DF effect, with higher recall of 'TBR' than ‘TBF’ words. This suggests that information can be intentionally forgotten as required, based on instructional cues. Additionally, word category influenced recall. The results showed that certain types of words, which in this case were sexual, were more likely to be recalled than others. Abuse related words were also recalled at a similar rate to sexual words. However, unlike sexual words, the results were non-significant when compared with body related words. Yet the abuse words were recalled more than household words.

This resembles previous findings within this thesis (Chapters 2-5), where abuse and sexual words can be considered emotional and the other two categories neutral. However, all categories were susceptible to DF. There was no interaction between cue and word type, suggesting that DF occurred within all categories regardless of the category.

In terms of the additional Cowan statistic, the results showed that the sexual words experienced less DF, especially in comparison to the body related words. It may be argued that sexual words are emotional and recalled better than more neutral information (body related words). Yet as indicated from the DF scores, all the categories were susceptible to DF effects.

7.5.2. Categories, valence and DF

Results showed that the recall of evocative stimuli was enhanced (Colombel, 2000; Doerksen & Shimamura, 2001; Ferre et al., 2015; Kensinger et al., 2002). Within this study, words were recalled better if they were sexual or abuse related, which has been supported by other research which argues that interrelated words are more likely to be recalled (Mandler, 1967; Puff, 1970; Marchewka et al., 2016; Talmi & Moscovitch, 2004; Tulving & Pearlstone, 1966). These sexual words may be more visual or more likely to create imagery that makes them easier to recall (Altarriba et al., 1999; Bauer et al., 2017; Bowen et al., 2018). Additionally, sexual words were less subject to DF in comparison to the 'body category', as shown by the Cowan statistic. However, based on the missing interaction between cue and category type, it can be assumed that each category is susceptible to being forgotten. This indicates that individuals can use the cue to forget words within specific categories, as shown by the DF score.

The categorical effect also coincides with emotional words, as these words are more likely to be recalled in comparison to neutral words, as seen with the sexual or abuse word categories (see Chapters 2-5). These results support Madan et al. (2017), who found taboo related words to be recalled best, suggesting that words that have some form of distinct feature (e.g. being taboo, sexual, etc.) may

indeed work separately from other emotional properties. This may explain why positive words were recalled better than neutral words in some of the previously reported experiments.

7.5.3. Considerations

Following the previous studies, this experiment followed considerations and necessary steps to ensure a fluid and valid study. However, there are some considerations for future research. Firstly, it has been argued that semantically related or categorised stimuli are important and this has been supported from this study and the previous study (Chapter 5). However, based on these findings it is not clear why previous studies did not find enhanced recall of negative stimuli, as they should be more likely to evoke vivid imagery compared to the positive stimuli. Yet within this study, it was the 'sexual' words that had the strongest effect. Based on this finding, it would be appropriate to test how these categories may influence recall by having each category include both positive and negative words.

To conclude, valence and categorisation have an important impact on recall. Yet DF seems to be consistent regardless, suggesting that while categorised stimuli influence recall, instructional cues work independently. Throughout each free recall study (Chapters 2 -5), the effect of cue has been shown, demonstrating that DF may be a very important factor in daily life. People can forget items intentionally and though there may not be a full depletion of TBF items at recall, there is a reduction in successful TBF recall regardless of the stimulus category.

Chapter 8.

General Discussion

8.1. Aims and summary of key findings

This thesis aimed to test intentional forgetting for emotional stimuli, with the intention of adding clarity to an uncertain topic, but it also assessed how various other variables might affect DF according to valence. The additional variables explored here have largely been overlooked and neglected in past work.

This thesis found DF across various scenarios and it was reported in all the free recall experiments. However, the overall DF effect was absent for the cued recall experiment. The thesis assessed whether emotional information can be intentionally forgotten through DF, where individuals use cues to consolidate a memory or remove it. Emotional stimuli indeed influenced recall, as emotional words were recalled more than neutral words. A positivity bias was also found within some experiments and while subsequent effects varied, when the data were pooled together, the positivity bias was evident for the TBR but not TBF cue (see Chapter 6).

The traditional DF effect was prominent in each study, except Experiment 3b, with stimuli being recalled better following a TBR than TBF cue. Other factors such as concreteness and word categories (e.g. 'sexual words') influenced recall, yet despite some specific stimulus effects, this thesis showed that the DF effect was generally a strong phenomenon. Other factors such as word type, word category, individual differences and delay could affect overall recall but not the DF effect. Most importantly, valence had a complicated relationship with DF, with positive stimuli seemingly being recalled the most following a TBR but not TBF cue, regardless of

any other additional implicating factors. Additionally, the cue and valence interaction was found in some experiments, but not all.

8.2. Retrieval method and robust DF

Throughout this thesis, TBR words were recalled more than TBF words, showing that DF was evident in every experiment that used free recall (Chapters 2-6), but not cued recall. The results regarding free recall support existing literature (see Appendix 14). In fact, those chapters that showed an interaction between cue and valence (Appendix 13; Chapters 2, 3, 4, 5) all indicated that valence influences recall, but the quantity of recall was due to the instructional cue (Basden & Basden, 1996; Baddeley et al., 2015; Johnson, 1994). This suggests that cues serve as reminders and dictate memory recall (Bjork, 1970; Bjork, 1972; Bjork & Geiselman, 1978). This was further supported from interactions between cue and word type (Chapter 5).

Delving more into the role of the cue, the results have shown how cues determine responses to each stimulus or memory item (see Chapter 1). To discuss this, it is firstly necessary to look at fundamental memory processes, where WM is an essential system in any cognitive task. WM plays a central role in the comprehension and analysis of information (Hasher & Zachs, 1988), especially when emotional stimuli capture attention and lead to better processing than neutral stimuli. This was seen within Experiments 1 to 5 and in past research (Blaney, 1986; Bradley et al., 2003; Liu et al., 2008; Todd et al., 2013; Kousta et al., 2009). This prioritised attention may lead to better performance within memory tasks and contribute towards recall (Wylie et al., 2008). Overall, data from the current thesis suggests that we can intentionally forget (Chapters 2-6). It is this adaption that leads us to function

daily but evades individuals like 'AJ' (Parker et al., 2006). Intentional forgetting was determined from the cue and valence interaction which identified that TBF recall was lower than TBR recall for all valences within free recall, as well as the DF score which was always above 0 within the free recall experiments.

However, the DF effect itself seemed to be dependent on the type of retrieval method. Free recall was used as the retrieval method for most experiments (Experiments 1- 3a, 4-5) as it was identified as being just as important as recognition, which has dominated the DF literature. Using free recall enabled an understanding of how valence affects recall within situations where retrieval cues may not be available. However, due to the chance of output interference, Experiment 3b replicated Experiment 3a but replaced free recall with cued recall (see Chapter 4). Cued recall eliminated DF, showing that words are not entirely forgotten within DF but are less accessible, as mentioned within Chapter 1.

In all the free recall experiments, positive TBR words were recalled more than neutral or negative words, whilst TBF recall differences were minimal. However, the differences between the three valence categories were not always significant. Additionally, other tests revealed that there was a higher DF for the neutral valence, whereas the cued recall study found no evidence for an overall DF effect, and indeed a reversed DF effect was seen for the negative words. The specific links between DF and valence is discussed further below.

8.3. DF and valence

In order to assess whether DF was dependent on valence, three different measures of DF were used. This thesis found that using three ways (ANOVA

interactions, Cowan scores and DF scores) of investigating valence effects within DF provided greater insights into intentional forgetting.

Firstly, with the pooled ANOVA (Chapter 6), an emotional bias was found, supporting previous literature (Anderson et al., 2004; Barnier et al., 2007; Blaney, 1986; Bradley et al., 2003; Cahill & McGaugh, 1998; Charles et al., 2003; Gray et al., 2002; Hamann, 2001; Kensinger & Corkin, 2004; Liu et al., 2008; McGaugh, 2003). This was particularly the case for positive TBR words within the free recall procedure. It may be that remembering the positive stimuli is less effortful than remembering negative stimuli due to the harmful impact negative information may have, whether this be general memory or real-life application of preserving a self-image (Sedikides & Green, 2009). Thus, in general the positive stimuli were recalled more than negative and neutral stimuli, as shown in the combined ANOVA. When broken down within each experiment, specific effects varied but emotional stimuli were recalled better than neutral stimuli following a TBF cue. This would suggest that emotional words in general go through less DF than neutral. Yet they are still susceptible to the broader DF effect.

In terms of the positivity bias, where positive words were better recalled following a TBR instruction within most experiments (2, 3b, 4, 5 & 6), this shows that when instructed, individuals can easily remember positive stimuli. This may be due to the attention given to the TBR items and the properties of the positively valenced information (Derryberry & Tucker, 1994).Yet with a majority of DF studies using recognition-based retrieval, it was always identified that negative stimuli are recognised better than other stimuli (Marchewka et al., 2016; Nowicka et al., 2011; Yang et al., 2012, 2016).

In the cued recall study (Experiment 3b), negative stimuli were harder to forget in comparison to neutral or positive stimuli. In that experiment, the positive TBR words were once again recalled more than negative or neutral words, yet the TBR neutral words were recalled more than negative words, which contrasts with the previous free recall experiments. However, within Experiment 3b's TBF cue, negative words were recalled better than neutral words. Moreover, when considering arousal, there was a reversal of the traditional DF effect, with TBF words being recalled more than TBR words if they were high in arousal. Similarly, neutral words were recalled better when high in arousal, compared to low arousal.

Studies such as Gallant and Dyson (2016) and Gamboa et al. (2017) also found enhanced retrieval of negative stimuli. Conversely, Bailey and Chapman (2012) identified a robust DF effect, alongside greater recall of positive words, which is in contrast with the results of Chapter 4. Another study, Otani et al. (2012), used all three valences (in the form of images instead of words). They found that recall was higher for negative than positive and neutral images, and negative images resisted DF. Otani et al.'s (2012) results indicate that just like results from the cued recall experiment, negative stimuli can resist DF. However, unlike what was found in this thesis, DF was reported amongst all valences, whereas in the cued recall experiment (Chapter 4) there was an overall absence of DF. Experiment 3b also showed that negative words underwent reversed DF, yet it should be stressed that overall recall of negative words was poor. A similar effect was reported by Li et al. (2017), who found that the neutral words were recalled better than negative words, though they did find a robust DF effect.

When considering the DF score as a measure of intentional forgetting (see Appendix 13), positive stimuli apparently experienced greater DF in comparison to

the other two valences. For the free recall experiments, the greater DF rate may be due to the TBR positivity bias, exaggerating the DF effect in comparison to the neutral and negative words. Based on the pooling of data (Chapter 6), it can be speculated that the TBF cue does indeed take attention away from the stimuli and in relation to the positive words, the words are inhibited just like the other valences (Zacks & Hasher, 1994; Zacks et al., 1996). This occurs regardless of any other properties, which had minimal effect on recall (Blaney, 1986; Bradley et al., 2003; Liu, Graham & Zorawski, 2008). As a general rule, the DF score did show successful forgetting of the emotional stimuli. However, it is also important to look at the enhanced recall of the TBF emotional stimuli in comparison to the neutral TBF stimuli. This would indicate that though TBF items are less accessible in general, indicating a traditional DF effect, TBF items are somewhat more available when the item involved is emotional in comparison to when it is neutral.

Lastly, the Cowan statistic analysis also provided insights into DF. Based on the combined analysis, emotional stimuli were recalled more than neutral stimuli (Chapters 2-4), which supports traditional findings that emotionally salient events are better remembered than neutral events. However, it was important to investigate how these results relate to DF, and the overall Cowan scores showed that the neutral words had a higher rate of DF in comparison to the negative and positive words (also supported by Hauswald et al., 2010), though this was mostly confined to Experiment 4. Even though the neutral words were forgotten more, the positive and negative words had minimal to no differences which could be a result of similar performance in the TBF condition. This was more evident within the free recall experiments, yet within the cued recall experiment, negative and positive words were again harder to forget in comparison to neutral words. The combined ANOVA

(Chapter 6) identified that the negative words also experienced reduced DF. This is somewhat in line with Experiment 3b's results, which showed that negative words were recalled more than the TBR equivalent, leading to a reversal of DF. This can be further cemented by the other interactions within Experiment 3b, which also identified that positive words underwent minimal DF.

8.4. Mechanisms of DF

As noted above, robust DF was found in the free recall experiments, and this can be explained in several ways. Selective rehearsal may have been used to encode and rehearse more TBR items in the time that TBF items were dismissed (Bjork, 1970; Bjork, 1972; Bjork & Geiselman, 1978). Conversely, the TBF cue may lead to the production of an inhibitory response for the associated stimuli, meaning they are temporarily inaccessible at the time of recall (Anderson & Huddleston, 2012; Anderson & Weaver, 2009; Baddeley et al., 2015; Johnson, 1994; Ullsperger et al., 2000; Wylie et al., 2008). This explanation is compatible with the free recall chapters within this thesis. Each experiment (1-5) was able to show that regardless of other manipulations to the stimuli, recall was dictated by the cue, resulting in better recall for TBR than TBF words. This shows that DF is robust and resistant to other manipulations to stimuli.

The question that arises here concerns differences in results. It is important to highlight that most of the studies that deal with valence focus on just negative and neutral stimuli, rather than a combination of all three valences (positive, negative and neutral). Additionally, recalling words is different to recalling images, so the stimulus type may play a role. Specifically, words have fewer attributes associated with them and hence may be encoded less distinctly than pictures (Dewhurst & Conway, 1994;

Rajaram, 1993). Nevertheless, whie this may be true to some extent, the work within this thesis showed that the retrieval method was especially important in the DF effect. Using cued recall led to different results than free recall, as discussed above. Within free recall, there was always a consistent DF effect, with TBR words being recalled more than TBF words, regardless of additional impacting factors.

This effect could also arise because participants are only focusing on TBR items, giving the TBF items an unfair disadvantage at recall. That is, the TBR words may have been more “available”, leading to output interference, but this has been challenged by Aguirre et al. (2020). To try and control for output interference in this project, Experiment 3b used cued recall, which was designed to prompt memories equally for both TBR and TBF items. If output interference played an important role, then the cued recall experiment would have led to equivalent recall of TBR and TBF words. Supporting this idea, the effect of cue was non-significant in Experiment 3b, which was the only experiment where cue did not have an effect (see Chapter 4). However, an interaction also revealed an advantage for negative TBF words, suggesting additional complex effects that may involve processes other than output interference. In summary, the DF effect found here may be influenced by output interference to some degree, and future studies should further explore this issue. Lastly, though this thesis did not intend to investigate the reasons behind DF itself, the manipulation of valence and DF relates to the mechanisms, hence the need to consider both retrieval methods.

Overall, from the discussions above and work within this thesis, the results from this thesis support the idea that emotional words do undergo DF, however they may be more resistant to DF in comparison to neutral words.

8.5. General valence findings

The priority for the experiment reported here was determining how DF is affected by valence. Yet the findings also present insights into the general role of valence on recall. In Experiments 1, 3 and 4 (Chapters 2, 4 & 5), there was greater recall of positive words (a positivity bias) in comparison to the neutral words. Negative words were only recalled more than neutral words within two experiments (1 & 2). Additionally, within Experiments 3 and 4, positive words were better recalled than neutral words, but no other significant differences were found. This variability is not just confined to this thesis but is common within the field of DF and emotional memory (Appendix 14 & Chapter 1). In fact, each of the experiments within this thesis identified uncontrolled factors that could have impacted the effect of valence. This may account for some of the variability in the valence effects. Based on these fluctuating results, an ANOVA combining the free recall data was used to determine the effect of valence. This unified analysis allowed an understanding of each valence and it identified that positive words were recalled more than neutral and negative words, especially within the TBR condition. Yet within TBF, there were minimal differences between positive and negative items.

Additionally, with the addition of short processing times between each emotional stimulus (see Chapters 2-6), there was a possibility that all emotional material (positive or negative) was treated in a similar way. Researchers such as Xie and Zhang (2017) have argued that post neurological consolidation can take hours to process and sometimes even longer. Thus, rather than attention being focused on the valence, it may be shifted towards other aspects such as instructions, timing and so on, in order to process everything efficiently.

As for negative words, they were recalled better than neutral words in Experiments 1 and 2. This somewhat contrasts with research from Depue et al. (2006), who identified that negative words were recalled less than neutral words. Within these chapters, the negative words were not leading to apprehensions that hinder recall (Cacioppo, 2004; Robinson, 1998). However, the fact that Experiments 3 and 4 had no such advantage for negative words insinuates that this is another complicated effect. Experiment 1 did see a rapid decline of negative word recall whereas there was a non-significant increase in recall for the neutral words, which could suggest that negative information may be grasped more quickly within memory but dropped just as rapidly (Brandt, et al., 2013; Depue et al., 2006). Yet the other experiments (2 & 5) did not replicate this effect. On the other hand, if the results of the combined ANOVA are considered (Chapter 6), there was better recall of negative than neutral words, suggesting that negative words in general do fare better in recall than neutral ones (Hauswald et al., 2010).

8.6. Time

This thesis also examined the role of time in DF and valence. Time did not affect the outcome of DF, which was reported at both short and long delays (Chapters 2, 3 & 5). This suggests that DF happens very quickly, providing further evidence for a fast-acting inhibition process for the TBF items. This fast-acting inhibition seems prevalent in a variety of tasks, including TNT (Anderson & Green, 2001), and could be used as evidence for the inhibition theory. The time effect seen within this thesis therefore supports the theory of active inhibition and not gradual decay within DF.

The role of time was investigated here because post-cue delay has varied within prior DF studies, which may have influenced the DF effect. This possibility was not supported here, though there was a general decrease in recall following longer delays in comparison to no delay or short delays (Chapters 2 & 5). While this supported general decay research (McKeown & Mercer, 2012; Ricker & Cowan, 2010), it reflected a moderate loss over time for *both* cues.

This finding challenges Hardt et al. (2013), who argued that decay is active and removes irrelevant information, which, within the context of DF, should strengthen TBR word recall and lead to a depletion of TBF recall at longer delays. Yet when comparing Experiments 1 and 2 with Experiment 4, having shorter, longer or no delay did not interrupt what was recalled as the 'TBF' instruction did not lead to worse recall when followed by a longer delay (further evidenced by the absence of delay interactions in all three experiments).

In regard to valence, delay length did not impact the recall of each valence dimension. In fact, the interaction between valence and delay was only significant within Experiment 1 (Chapter 2) and other experiments (2 & 4) that included delay as a variable lacked this interaction. Valence effects appear independent to delay length and additional time is not needed for an enhancement of emotional material (as seen from the lack of interactions). Emotionally valenced stimuli were prominently recalled regardless of the duration of any post-cue delay.

This thesis has thus successfully outlined how DF occurs regardless of time and decay did not work 'actively'. Additionally, delay did not reinforce or help inhibit certain valences more than others, as suggested by previous literature (see Chapter 1).

8.7. Stimulus characteristics

This thesis considered stimuli characteristics to be important as they had been neglected or uncontrolled for within prior studies and literature. The stimuli were always adapted for each experiment, however two experiments focused specifically on the word categories (Chapter 7) and word type (Chapter 5). From each experiment there were two important factors to consider; *a*) importance of the type of stimuli, *b*) the way stimuli are tested. This is also supported by Depue et al. (2006). Firstly, the type of stimuli is important as it influences what is recalled, which can be more clearly identified within the fourth (Chapter 5) and the last experiment (Chapter 7), where the focus shifted onto stimulus type. Here DF was reported for neutral, control categories, yet there was a shift in attention towards sexual words and concrete words, which were easier to recall. This suggests that, within recall, it is the actual intensity and significance of that item which determines its retrievability. It can be argued that all these types of stimuli are still susceptible to DF, but certain properties of the stimuli lead to better capture of attention than other stimuli. This leads to less forgetting for some stimuli than others.

To some extent this can be linked to Sharot et al. (2007), who said memory favours emotionally significant events rather than mundane events, and this can apply to both negative and positive stimuli. Hence something which is sexual in nature might be remembered better due to its properties or emotional significance, intensity or passion (Charles et al., 2003; McGaugh, 2013). This would also explain why concrete words were recalled better within Experiment 4, compared to abstract words, regardless of whether they were positive or negative.

As for word categories (Chapter 7) or word type (Chapter 5), they did not affect DF. Once again, the instructional cue influenced recall and led to non-existent interactions between these other variables and the cue. These factors may possibly work as additional context influencers (Bransford & McCarrell, 1974) that enhance the encoding for the instructional cues, but not to the extent of disrupting the instructional cue's role. As both cue-related words are rehearsed separately, where TBR items are rehearsed more extensively (Bjork, 1972), the items themselves are not being disrupted based on their properties as they are already being processed based firstly on cue and, within that, they are encoded based on other characteristics (i.e. emotional significance, meaning, imageability and so on). TBF items are not fully eradicated within memory, but rather inhibited or limited at the time of both free recall and cued recall. This explains why words with personal connotations, such as 'sexual' related words, were recalled best, followed by 'abuse' related words, in Experiment 5. Both word types grab attention but are processed based on the individual's needs, and in this case instructional cues. However, it can also be argued that if measures are taken to make the TBF items easier to recall, then DF can be overcome.

8.8. DF and individual differences

Results within this thesis further dismissed individual factors such as mood (Chapter 5) and sex differences (Chapter 4) as interacting with DF. Emotional reactivity (Chapter 5) did correlate with recall of specific cue/valence combinations, but the overall DF effect was not impacted. These individual differences may not heavily influence the way intentional forgetting works.

Elements of 'mood' or 'emotional reactivity' can influence the type of stimuli/events that are remembered (Bower,1981; Rusting, 1998), as mood state may be used to interpret the scenario accordingly and be used as a trigger for later recall. However, as noticed within Experiment 4, this was not the case, as individuals were able to follow the cues, regardless of a positive or negative mood. For mood and emotional reactivity, the individual may need to be in a more heightened state in order for mood to influence DF. This is supported by studies such as Badli and Dzulkifli (2013), who worked with dysphoric individuals.

Within emotion, 'arousal' is a domain that is very important (Hamann, 2001). Arousal may relate to mood too, where an individual who has a more intense negative mood would recall more negative words, and analogous effects could be seen in someone experiencing an intense positive mood. It can be argued that the current mood and emotional reactivity of the participants may have been at baseline or ‘neutral’, as both mood and emotional reactivity effects were not as pronounced, leading to minimal impact on recall. Furthermore, stimulus processing may be due to the individual's perception rather than biological constructs, hence in Experiment 3, sex differences within recall were minimal or non-existent.

8.9. Limitations and future directions

Though steps were taken to ensure the present experiments featured high methodological standards, there are limitations that will be discussed alongside potential future considerations.

Throughout this project, young adults were primarily used as participants. Though a generic critique within memory or cognitive studies, participant age may play a role. In accordance with some literature, it has been suggested that older

adults are more likely to focus attention towards positive emotional events (Carstensen & Fredrickson, 1998; Citron et al., 2013; Fredrickson & Carstensen, 1990; Fung, Carstensen, & Lutz, 1999; Hashtroudi et al.,1990; Isaacowitz, Wadlinger et al., 2006; Mather & Carstensen, 2005; May et al., 2005) in comparison to younger adults, who focus on negative emotional events. This would suggest a processing gap for emotion between the young and the old, as research has argued that with the passing of age, negative affect is experienced less frequently (Charles et al., 2001).

However, though age was not formally tested, participants were not restricted to a certain age group. Additionally, Berger et al. (2016) have actually researched age in the context of DF, where they tested three groups: young (20-35 years), young-old (60-74 years) and old-old (75-89 years) adults. They found that DF was unaffected by age, as all three groups showed intentional forgetting, regardless of valence. This suggests that intentional forgetting of emotional stimuli is not influenced by the age of the participants. Similarly, the individual differences explored here (mood, emotional reactivity [Chapter 4]) and sex (Chapter 3) did not mediate or moderate DF.

The samples within this study also tended to be undergraduate psychology students, and it would be helpful to test non-academic populations and explore variations within students. As individuals within the university are diverse, looking at different cohorts at different times of the academic calendar might influence how emotional information is processed. Academic stress can lead to forgetting, with Ramirez, McDonough and Jin (2017) reporting that students who found their course to be a more stressful experience were more likely to have a decline in exam performance and show greater forgetting. These students were also the ones who

actively tried to stop thinking about the course after it had finished (suppression). This suggests that timing and material is important to students, which may be relevant to DF and valence. Hence, assessing the impact of academic stress, especially around the times of different tasks (exams, assignment submission) within different age groups could be a useful way of testing whether these individual differences impact intentional forgetting.

Additionally, the stimuli used here were not specific to the group of students. Rather, they enveloped daily objects and concepts. However, if they were more specific to academic concepts then there may have been a greater impact on recall. As it is well known that events that are more personal to the individual are more likely to be remembered, changing the stimuli to cater to the participants may provide a better way to test valence differences within DF.

Lastly this thesis focused on words, but DF has also been explored for images (see Chapter 1), human faces (Goernert et al., 2011), symbols (Hourihan et al., 2009) and even phone numbers (Gottlob et al., 2006). Using different stimuli adapted to different contexts may have allowed greater scope to understand the types of information that can be intentionally forgotten. Words may be quite mild in their emotional impact and even though they still influence recall based on emotionality, using stimuli such as pictures could be more relevant to everyday life.

8.10. Implications

In the field of DF, much research focuses on those diagnosed with trauma, PTSD, depression, social anxiety, and so on, and examines valence effects (see Cottencin et al., 2006; Dumont, 2000; Kuehl, et al., 2017; Korfine & Hooley, 2000;

Liang et al., 2011; McNally et al., 1998; Moulds & Bryant, 2002; Sahakyan et al., 2019; Tolin et al., 2002; Wilhelm et al., 1996; Zwissler et al., 2011). The results from these studies typically show that negative stimuli are recalled or recognised better than positive or neutral stimuli. In fact, depending on the clinical diagnosis, the material or stimuli learnt will be influenced by certain characteristics. An example of this bias concerns social anxiety, where highly socially anxious individuals will automatically focus on stimuli that may seem more socially threatening in comparison to other stimuli (Beck, Emery & Greenberg, 1985).

However, this bias is not just limited to those with social anxiety and is common in other disorders. For example, Wilhelm et al. (1996) found that individuals who are diagnosed as OCD cannot stop intrusive thoughts. In terms of the DF paradigm, when these individuals are shown positive, negative and neutral words, they are more likely to find it harder to forget the negative words than the other two valences. These results show how, within DF, it is easier for clinically diagnosed samples to identify with the negative material.

Interestingly, studies such as Wilhelm et al. (1996) have been criticised for their use of stimuli, as they were specific to the genre of OCD, where the negative words were more relevant to the disorder and the neutral words were not (Tolin et al., 2002). As McGaugh (2013) has pointed out, the strength of any memory is very much dependent on how relevant it is to the person, especially in terms of emotional significance. Stimuli that are more relevant to someone diagnosed with OCD may not have the same impact on another who is not clinically diagnosed with OCD.

Looking at the above argument, stimuli are important in DF and the characteristics of the words can influence retrieval (see Chapters 5 & 6), whether the participants be clinically diagnosed participants or non-clinically diagnosed

participants. Additionally, Sahakyan et al. (2019) found that participants with positive schizotypy found it harder to forget the TBF items, whereas the TBR items were unaffected. This further suggests that clinical samples might show impaired DF, especially when emotional content is also factored in. Thus, the DF paradigm works in a robust manner and while this thesis shows robust DF within free recall, clinical sample populations can lead to different results.

Coinciding with previous research and the findings from this study (Chapters 2-6), DF can be a very useful method in a variety of circumstances and situations, whether it be based on academic backgrounds, as pointed out from this thesis, or a clinical background. The DF paradigm itself may be a useful tool to help individuals in possible areas of academic stress or adjusting from trauma and stress. In fact, Moulds and Bryant (2002) have used the item-method of DF to state that trauma survivors might be able to forget disturbing materials. Yet it is also important to highlight how DF can work in the opposite manner by inducing more thoughts related to the subject trying to be suppressed (see Geraerts & McNally, 2008). Thus, the paradigm of DF may not work to fully suppress unwanted information on a larger or more personal scale. But it may help individuals to adjust to situations, and a phenomenon like exam stress within an academic setting may be best combated if positive motivators are used as cues to lower anxiety and stressors related to that specific event. This makes DF a good contender to be used in daily situations.

8.11. Conclusions

This thesis expanded on previous literature concerning DF and valence. It did this by examining factors such as; post-cue delay, arousal, concreteness, sex, mood, emotional reactivity, categories and the retrieval method as well to see how they may

influence successful intentional forgetting and how they could potentially contribute to the contradictory findings concerning valence. Within the free recall procedure, each valence was susceptible to DF, yet the positive and negative items experienced the least DF. Within the cued recall experiment, there was a DF reversal for some valences and an overall absence of DF. The results from both retrieval methods identify that regardless of how words are recalled, valence is an important factor in DF. In fact, in the free recall tasks positive TBR words were generally recalled better than the other valences. For TBF words, the overall positivity bias was missing, though positive words were generally recalled better than neutral words. Other factors, such as individual differences i.e. mood and emotional reactivity, did not affect DF. In summary, research within this thesis helped to identify potential characteristics of stimuli that may be a source of consideration for future DF studies. This thesis also tested variables that may explain why previous literature has yielded inconsistent results. While many of the factors tested did not affect DF, the retrieval method was very important.

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Appendices:

Appendix 1-

'To Be Remembered' Cue for experiments 1-5

TBR

Appendix 2 - 'To Be Forgotten' Cue for experiments 1-5

TBF

Appendix 3- Stimuli for Experiment 1:
Word list Adapted from:
The ANEW list (Bradley & Lang, 1999)

Delay (s)	Positive	Neutral	Negative
0.5	Joy	Air	Fat
10	Win	Boy	Lie
0.5	Dove	Milk	Lice
10	Lust	Name	Ugly
0.5	Love	Plant	Stool
10	Loyal	Watch	Ulcer
0.5	Famous	Window	Corpse
10	Spring	Cannon	Fungus
0.5	Justice	Lantern	Pervert
10	Diamond	Machine	Poverty
0.5	Intimate	Hospital	Immature
10	Graduate	Elevator	Impotent
0.5	Valentine	Lightbulb	Suffocate
10	Fireworks	Repentant	Infection
0.5	Sweetheart	Lighthouse	Loneliness
10	Acceptance	Astonished	Suspicious
0.5	Hug	Ink	Hit
10	Fun	Toy	Rat
0.5	Kiss	Book	Slum
10	Sexy	Idol	Fire

0.5	Comedy	Social	Knife
10	Angel	Metal	Panic
0.5	Luxury	Icebox	Beggar
10	Profit	Salute	Manure
0.5	Snuggle	Whistle	Grenade
10	Aroused	Opinion	Seasick
0.5	Paradise	Medicine	Massacre
10	Pleasure	Mushroom	Mutilate
0.5	Protected	Appliance	Decompose
10	Beautiful	Orchestra	Nightmare
0.5	Excellence	Inhabitant	Distressed
10	Respectful	Nonchalant	Disdainful

Appendix 4 - Stimuli for Experiment 2
Word list Adapted from:
THE ANEW list (Bradley & Lang, 1999)

Delay	Positive	Neutral	Negative
1.5	Fun	Odd	Mad
10	Nude	Cane	Rage
1.5	Comedy	Naked	Slave
10	Erotic	Revolt	Bloody
1.5	Miracle	Reunion	Assault
10	Intimate	Clothing	Disaster
1.5	Fireworks	Hamburger	Nightmare
10	Perfection	Nonchalant	Displeased
10	Win	Hat	Lie
1.5	Lust	Idol	Rape
10	Angel	Candy	Abuse
1.5	Orgasm	Salute	Sinful
10	Diamond	Lantern	Bastard
1.5	Paradise	Kerosene	Mutilate
10	Valentine	Appliance	Slaughter
1.5	Excellence	Employment	Suspicious

Appendix 5 - Stimuli for Experiment 3
Word List Adapted from:
The ANEW List (Bradley & Lang, 1999)

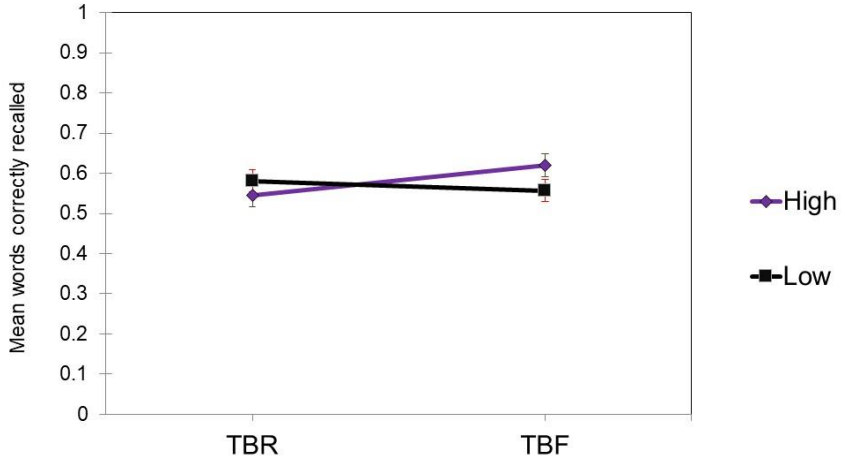
Positive High arousal	Positive Low arousal	Neutral High arousal	Neutral low arousal	Negative High arousal	Negative low arousal
Fame	Heal	Hide	Lamp	Bomb	Meek
Lust	Dove	Lion	Knot	Rape	Tomb
Heart	Sleep	Storm	Horse	Angry	Mucus
Orgasm	Nectar	Chance	Pencil	Killer	Manure
Admired	Snuggle	highway	Cabinet	Hostage	Malaria
Romantic	kindness	hospital	nonsense	Mutilate	Immature
Cash	Cozy	Cliff	Cork	Flood	Scar
Kiss	Bird	Cold	Cane	Hate	Pity
Loved	Angel	Boxer	Metal	Panic	Gloom
desire	Bunny	Doctor	Insect	Scream	Coward
aroused	Comfort	vampire	Prairie	Assault	Corrupt
treasure	Grateful	neurotic	Reserved	Murderer	Handicap

Appendix 6 – Two way ANOVA results for Experiment 3b

The second interaction between cue and arousal was also significant (F[1, 51] = 13.03, p = .001, η_p^2 = .20 [Figure 4.5.]).The graph below indicates that the low arousal words declined from TBR to TBF, in line with usual DF, whereas for high arousal words there was an incline and reversal of DF.

Figure 4.5.

Mean proportion of words correctly recalled according to cue and arousal. Error bars show 95% CIs calculated according to Jarmasz and Hollands (2009).



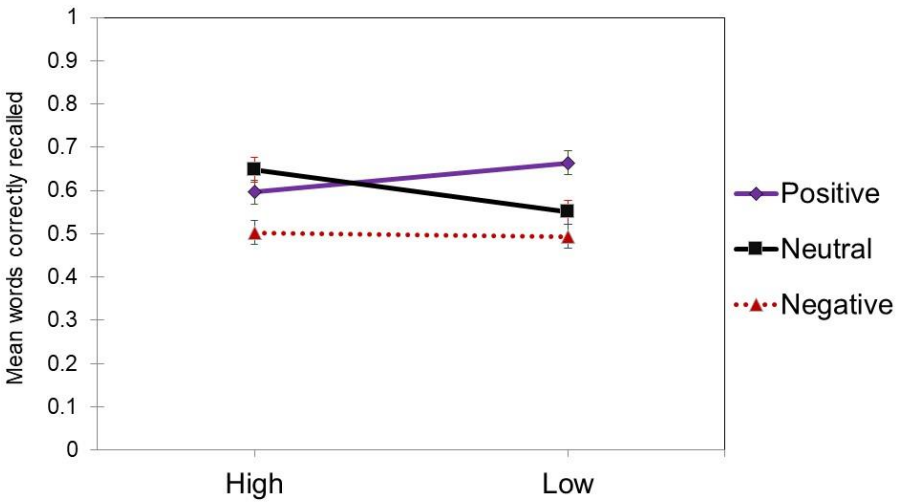
To explore this interaction, paired-sample t-tests were conducted again with the p-value being adjusted using the Holm-Šidák correction. There was a significant difference (t[51] = -4.042, p = .001, r = .49) between the TBR high arousal (M = .54,

SD = .13) and the TBF high arousal words (*M* = .62, *SD* = .14), with the TBF high arousal words being recalled more. Conversely, there was a non-significant difference between TBR high and TBR low arousal words (*M* = .58, *SD* = .15; *t*[51] =-1.72, *p* = .092, *r* = 0.23). There was also a non-significant difference between TBR high and TBF low arousal words (*M* = .56, *SD* = .15;*t*[51] = -.49, *p* = .630, *r* = 0.07). The TBF high (*M* = .61, *SD* = .12) and TBF low arousal words also showed a significant difference (*M* = .54, *SD* = .15; *t*[51] = -3.03, *p* = 0.04, *r* = 0.36), with the high arousal words being recalled more than the low arousing words. Lastly, there was a non-significant difference between TBR low and TBF low arousal words (*M* = .56, *SD* = .15; *t*[51] = -1.18, *p* = .243, *r* = 0.16).

The valence and arousal interaction (*F*[2, 102] = 17.07, *p* <.001, η_p^2 = .25) was significant too (Figure 4.6). The graph below indicates that positive words were recalled better when low in arousal, whilst neutral words were better recalled when they were high arousal. The negative words were recalled at a similar rate for both arousal levels. The neutral words were recalled more than positive or negative words when high arousing, but for low arousing words there was an advantage for positive stimuli.

Figure 4.6.

Mean proportion of words correctly recalled according to valence and arousal. Error bars show 95% CIs calculated according to Jarmasz and Hollands (2009).



To explore this interaction, paired-sample *t*-tests were conducted with the *p*-value being adjusted using the Holm-Šidák correction. There was a significant difference between the high arousing positive words (M = .60, SD = .15) and high arousing neutral words (M = .65, SD = .12; t[51] = -2.79, p < .001, r = .36) with neutral words being recalled more. Significant findings were also observed when comparing the high arousing positive words and high arousing negative words (M = .50, SD = .17; t[51] = 3.46, p = .003, r = .44) with positive words being recalled more. Similarly, there was a difference between high arousing neutral and negative words (t[51] = 6.06, p < .001, r = .65), with neutral words being recalled more.

Significant findings were also observed when comparing positive low arousing words (M = .66, SD = .15) with equivalent neutral words (M = .55, SD = .18; t[51] = 4.80, p < .001, r = .56), with positive words being recalled better. There was also a difference between the low arousing positive and negative words (M = .49, SD = .13; t[51] = 9.47, p < .001, r = .80), with positive words once again being recalled better. Lastly, a significant difference was observed between the low arousing neutral and negative words (t[51] = 2.91, p =.007, r = .38), with neutral words being recalled better.

Appendix 7 - PANAS Scale for Pilot study & Experiment 4

PANAS Questionnaire (Mood Questionnaire)

To get a copy of the PANAS questionnaire, please see the link
[http://homepages.se.edu/cvonbergen/files/2013/01/Development-and-Validation-of-Brief-Measures-of-Positive-and-Negative-Affect_The-PANAS-Scales.pdf]

Appendix 8 - Affective slider for Pilot study
Adapted from:
Betella and Verschure (2016)

To gain access at the Affective slider, please see the link

[https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0148037#:~:text=The%20%E2%80%9CAffective%20Slider%E2%80%9D%20(AS)%20is%20a%20digital%20scale,that%20measure%20pleasure%20and%20arousal.&text=As%20a%20result%2C%20dominance%20can,a%20consequence%20of%20core%20affect]

Appendix 9 - Stimuli for the Pilot Study

Adapted from:

Paivio, Yuille and Madigan (1968)

Rating words on pleasure and arousal

You will now be shown a list of randomised words. Use the given slider scale to rate each word within the domain of pleasure and arousal. For each word use the slider to indicate the rating you feel is best fit to describe how pleasant you feel the word is (pleasure) and how intense the word is (arousal) .

Abstract Words	Concrete Words
Hope	Infection
Chance	Salary
Confidence	Victim
Mood	Injury
Loyalty	Venom
Hatred	Disease
Mercy	Malaria
Anxiety	Air
Deceit	Decoration
Joy	Shriek
Shame	Nightfall
Greed	Beverage
Malice	Author
Ignorance	Sunset
Afterlife	Thief
Betrayal	Bosom

Jealousy	Kiss
Democracy	Bandit
Competence	Cash
Grief	Officer
Spirit	Admiral
Fallacy	Lice
Nonsense	Bacteria
Co-operation	Slave
Ego	Weapon
Insolence	Gem
Happiness	Nectar
Freedom	Python
Fantasy	Beast
Intimate	Hurricane
Pacifism	Sunburn
Disparity	Candy
Pleasure	Utensil
Devil	Painter
Affection	Dollar
Hostility	Flood
Justice	Leaflet
Miracle	Prison
Safety	Clothing
Trouble	Money

Misery	Reptile
Humour	Fire
Welfare	Fur
Abbess	Jail
Atrocity	Hall
Sadness	Animal
Time	Gold
Emancipation	Nun
Chaos	Vegetable
Demon	Sea
Impotency	Seat
Abdomen	Hospital
Crisis	Magazine
Fault	Missile
Blasphemy	Blood
Sobriety	Volcano
Violation	Alcohol
Hardship	Piston
Victory	Tank
Death	Thorn
Ghost	Tobacco
Goddess	Woods
Silence	Corpse
Agony	Paper

Poverty	Cotton
Brutality	Dove
Emergency	Flesh
Exhaustion	Leggings
Abduction	Alligator
Comedy	Boy
Promotion	Butterfly
Prayer	Scorpion
Pressure	Clock
Ritual	Diamond
Casualty	Doll
Homicide	Fork
Creator	Arm
Warmth	Bagpipe
Disaster	Beaver
Assault	Snake

Appendix 10 - Perth Emotional Reactivity Scale (PERS) for pilot study and experiment 4

Adapted from Becerra &Campitelli (2013)

To get a copy of the PERS questionnaire, please see the link

[https://www.researchgate.net/publication/314157839_Perth_Emotional_Reactivity_Scale_PERS_Copy_of_questionnaire_and_scoring_instructions]

Appendix 11 – Stimuli for Experiment 4- Adapted from the Pilot study

Positive Words	Type	Neutral Words	Type	Negative Words	Type
Hope	Abstract	Mood	Abstract	Crisis	Abstract

Safety	Abstract	Prayer	Abstract	Misery	Abstract
Joy	Abstract	Welfare	Abstract	Fallacy	Abstract
Intimate	Abstract	Sobriety	Abstract	Assault	Abstract
Promotion	Abstract	Democracy	Abstract	Homicide	Abstract
Humour	Abstract	Ritual	Abstract	Agony	Abstract
Comedy	Abstract	Spirit	Abstract	Hatred	Abstract
Goddess	Abstract	Creator	Abstract	Sadness	Abstract
Chance	Abstract	Silence	Abstract	Betrayal	Abstract
Confidence	Abstract	Pacifism	Abstract	Impotency	Abstract
Sunset	Concrete	Seat	Concrete	Weapon	Concrete
Animal	Concrete	Cotton	Concrete	Injury	Concrete
Sea	Concrete	Officer	Concrete	Sunburn	Concrete
Beverage	Concrete	Magazine	Concrete	Missile	Concrete
Butterfly	Concrete	Leggings	Concrete	Bacteria	Concrete
Dove	Concrete	Beaver	Concrete	Venom	Concrete
Dollar	Concrete	Python	Concrete	Corpse	Concrete
Diamond	Concrete	Painter	Concrete	Tobacco	Concrete
Money	Concrete	Utensil	Concrete	Hospital	Concrete
Decoration	Concrete	Vegetable	Concrete	Hurricane	Concrete

Appendix 12 - Stimuli for Experiment 5

Word list adapted from:

The ANEW list (Bradley & Lang, 1999)

Abuse		Sexual		Household objects		Body	
TBR	TBF	TBR	TBF	TBR	TBF	TBR	TBF
Hit	Gun	Hug	Sex	Bowl	Fork	Hand	Face
Rape	Slap	Kiss	Lust	Wine	Tool	Chin	Foot
Whore	Cruel	Naked	Flirt	Knife	Watch	Ankle	Elbow
Insult	Scream	Virgin	Orgasm	Pillow	Bottle	Wounds	Finger
Quarrel	Hostile	Pervert	Passion	Bouquet	Bathtub	Wink	Grin
Massacre	Mutilate	Intimate	Impotent	Computer	Scissors	Headache	Handicap
Suffocate	Slaughter	Infatuation	Intercourse	Cabinet	Ketchup	Vomit	Mucus

Appendix 13 - Tables representing interactions within valence amongst DF for each experiment

Valence effects

Experiment	Positive (M)	Neutral (M)	Negative (M)	Significance within Šidák 'x'		
				Positive to neutral	Positive to negative	Negative to neutral
1	.19	.12	.17	X	X	X
2	.28	.21	.28	X	-	X
3	.15	.10	.12	X	-	-
4	.16	.13	.15	X	-	-

Categories	House Hold	Body	Sexual	Abuse	Sexual to abuse	Abuse to household	Sexual to Household	Household to body
5.	.19	.18	.31	.23	X	x	X	-

Cue x valence

Experiment	Significant	Positive (M)		Neutral (M)		Negative (M)	
		TBR	TBF	TBR	TBF	TBR	TBF
1	Yes	.30	.08	.18	.04	.24	.07
2	No	.41	.16	.32	.09	.41	.15
3	No	.19	.10	.14	.06	.16	.08
4	Yes	.25	.07	.20	.06	.21	.08

Categories	Significant	Household		Body		Sexual		Abuse	
		TBR	TBF	TBR	TBF	TBR	TBF	TBR	TBF
5.	No.	.26	.10	.28	.10	.39	.23	.30	.16

DF score

Experiment	Significant?	Positive (M)	Neutral (M)	Negative (M)
1	YES	.22	.15	.17
2	NO	.25	.23	.26
3	NO	.10	.08	.08
4	YES*	.18	.15	.14

(4. *Šidák showed non-significant findings*)

Experiment	Significant	Household	Body	Sexual	Abuse
5.	NO	.15	.17	.16	.14

Cowan statistic

Experiment	Significant?	Positive (M)	Neutral (M)	Negative (M)
1	NO	.69	.68	.71
2	NO	.45	.66	.51
3	NO	.38	.53	.39
4	YES*	.64	.74	.57

(4. Šidák showed non- significant findings)

Experiment	Significant	Household	Body	Sexual	Abuse
5.	YES	.57	.68	.29	.42

(5. Šidák showed significant findings for sexual words and body related words)

Appendix 14 - Table representing the Item-Method of DF

Title	Authors	Year	Study Description
Yang, Lee & Anderson	(Decreased inhibitory control of negative information in directed forgetting)	2016	**Materials & Procedure:** 36 neutral, 32 negative words (Chinese Nouns). - fMRI study - Recognition test. **Results:** - Recogntition for TBR words were significant - Neutral words had a higher DF effect. - Negative & Neutral were both easily suppressed.
Cheng, Liu, Lee, Hung & Tzeng	Intentional forgetting might be more effortful than remembering: An ERP study of item-method directed forgetting	2012	**Materials & Procedure:** - 80 words (Chinese nouns) -Recall **Results:** -Main effect of cue duration was found to be significant - TBR words were significantly recalled more. - Interaction between two cues also significant.
Gallant & Dyson	Neural modulation of directed forgetting by valence and arousal: An event-related potential study	2016	**Materials & Procedure:** - Mixture of high and low arousing positive, negative, and neutral words. - Item method and recall **Results:** - Traditional DF effect with greater recognition for TBR words than TBF. -Found reduced less DF for negative and lower suppression levels in comparison to other valences.
Fawcett & Taylor.	Forgetting is effortful: Evidence from reaction time probes in an item-method directed forgetting task	2008	**Materials & Procedure:** - 240 nouns from a database; 3-12 letters long, mean of 6.08 letters. - Words shown with an 'R' or 'F' instructions after (remember or forget) -Recognition test. - Probe task was also inserted between trials. **Results:** - Traditional DF effect

			- Led to another similar experiment with similar strong DF results.
Wylie, Foxe & Taylor	Forgetting as an Active Process: An fMRI Investigation of Item-Method–Directed Forgetting	2008	**Materials & Procedure:** - 200 words use from same database as Fawcett & Taylor. Mean letter 6.36, words also looked at through imagery, meaningfulness, concreteness and syllables. - Used a string of X's in either red or yellow colour to signify whether to remember or forget. -Recognition test **Results:** - Traditional DF effect - fMRI supports distinguished memory for both R and F instructions.
Nowicka, Marchewka, Jednoróg, Tacikowski&Brechmann	Forgetting of Emotional Information Is Hard: An fMRI Study of Directed Forgetting	2011	**Materials & Procedure:** -240 Images from IAPS; neutral and negative (emotions such as fear and disgust). - Each image with instruction of 'R' or 'F' in phase one, in phase two had similar procedure but with addition of new images. -Recognition task **Results:** - Traditional DF effect - Found higher recognition for TBR negative images and less DF for them against neutral images.
Van Hooff, Whitaker & Ford	Directed forgetting in direct and indirect tests of memory: Seeking evidence of retrieval inhibition using electrophysiological measures	2009	**Materials & Procedure:** - 360 one syllable noun words; 3–6 letters in length -Participants did the DF task as a study task, followed by a lexical-decision task, and a recognition-memory task. **Results:** - Traditional DF results with recognition rates higher for TBR than TBF words.
Sahakyan & Foster	Intentional forgetting of actions:	2009	**Materials & Procedure:**

	Comparison of list-method and item-method directed forgetting		- Conducted four experiments, three of used the list method design. The fourth was an item method design. - Phrases were used rather than singular words with cues after each phase. -Recall test **Results:** - Traditional DF effect with higher recall of TBR phrases against TBF.
Yang, Liu, Xiao, Li, Zeng, Qiu, & Zhang.	Different neural substrates underlying directed forgetting for negative and neutral images: An event-related potential study	2012	**Materials & Procedure:** - Used negative and neutral images. - TBR and TBF instructions after each image -Recognition task **Results:** - Traditional DF effect -More hits for negative than neutral images.
Marchewka, Wypych, Michalowski, Sinczuk, Draps, Jednorog & Nowicka	What Is the Effect of Basic Emotions on Directed Forgetting? Investigating the Role of Basic Emotions in Memory	2016	**Materials & Procedure:** - 280 Images taken from NAPS database based on disgust, fear, sadness and neutral. Each image with a TBR or TBF instruction. - 30 minute break after presentation. -Then a rating task based on the pictures shown. -Recognition task **Results:** - Traditional DF results. -Recognition rate higher for emotional images than neutral images. Disgust better remembered than sadness. - Found emotions to have no effect on DF.
Bastin, Feyers, Majerus, Balteau, Degueldre, Luxen, Maquet, Salmon & Collette	The neural substrates of memory suppression: a FMRI exploration of directed	2012	**Materials & Procedure:** - 200 six letter words used. - Each word was assigned with a cue, TBR or TBF, though lists were counterbalanced. - Distraction task was also added after the learning phase. - An fMRI analysis was also done. **Results:** - Traditional DF effect with more recognition for TBR items than TBF.

Zwissler, Koessler, Engler, Schedlowski, &Kissler.	Acute psycho-social stress does not disrupt item-method directed forgetting, emotional stimulus content does	2011	**Materials & Procedure:** - 75 pair of images shown (positive sand neutral) - Each image with a Remember 'mmm' or forget 'vvv' instruction was shown. -Learning phase, recogntion Phase with saliva cortisol sampling and psychological assessment. -Recognition task. **Results:** - Traditional DF effect with more R hits than F. -More hits for neutral than positive images.
Cottencin, Vaiva, Huron, Devos, Ducrocq, Jouvent, Goudemond & Thomas.	Directed forgetting in PTSD: A comparative study versus normal controls	2006	**Materials & Procedure:** - Two groups: control and PTSD group - Had four lists of words - Performed DF task, stroop test and verbal fluency test. -Recall was used **Results:** - PTSD patients remember fewer 'R' words than controls. Correct amount of words recalled also lower than controls. Also remembered more forget words than controls.
Dewhurst, Anderson, Howe & Clough	The relationship between mental toughness and cognitive control: Evidence from the item-method directed forgetting task	2019	**Materials & Procedure:** - Recognition task -Extended a previous study **Results:** - They found a positive link between recognition of TBR words and on the emotional control subscale. -No significant link between personality and mental toughness.
Augusti & Melinder	The effect of neutral and negative colour photographs on children's item directed forgetting	2012	**Materials & Procedure:** - Used neutral and negative images - Used children as participants (8-12 years). **Results:** - Standard DF for both neutral and negative images
Gallant & Yang	Positivity effect in source attributions of arousal-matched	2014	**Materials & Procedure:** - 120 words: positive, negative and neutral based on valence and arousal

	emotional and non-emotional words during item-based directed forgetting		-Recognition task - PANAS questionnaire was also completed **Results:** - Traditional DF effect - Valence was significant- positive words better recognised followed by negative and then neutral words
Taylor, Cutmore& Pries	Item-method directed forgetting: Effects at retrieval?	2018	**Materials & Procedure:** - Three experiments with similar procedure and slight changes based on participant numbers and cue colours. - 320 words, Recognition task **Results:** - All experiments showed a DF effect with higher hits for TBR words.
Taylor, Quinlan &Vullings	Decomposing item-method directed forgetting of emotional pictures: Equivalent costs and no benefits	2018	**Materials & Procedure:** - Used positive, neutral and negative images -Recognition task **Results:** - Traditional DF effect - Selection of encoding happens regardless of emotional content.
Liu, Chen & Cheng	Selective rehearsal is affected by the emotionality of the encoding context in item-method directed forgetting: An event-related potential study	2017	**Materials & Procedure:** - 480 Chinese character words: negative and neutrally valenced -Recognition task -ERP recordings also done **Results:** - Traditional DF effect -Valence also significant: neutrally valenced context words remembered better than negative.
Hsieh, Hung, Tzeng, Lee, Cheng	An event-related potential investigation of the processing of Remember/Forget cues and item encoding in item-method directed forgetting	2009	**Materials & Procedure:** - Recognition Task on words - ERP's recorded **Results:** - Traditional DF effect

Sell	Applying the intentional forgetting process to forgiveness	2016	**Materials & Procedure:** **-** Three experiments conducted -Used story narratives rather than single words **Results:** - Having 'remember' or 'forget' was important to whether participants 'forgave'. - DF effect.
Hauswald&Kissler	Directed forgetting of complex pictures in an item method paradigm	2008	**Materials & Procedure:** - Series of coloured images used -Recognition task **Results:** - Standard DF effect -DF correlated negatively with participants depression
Van Hooff& Ford	Remember to forget: ERP evidence for inhibition in an item-method directed forgetting paradigm	2011	**Materials & Procedure:** - Series of words - ERP's examined - Recognition task **Results:** - DF effect
Quinlan, Taylor & Fawcett	Directed Forgetting: Comparing Pictures and Words	2010	**Materials & Procedure:** **-** Two experiments **-** 288 photographic stimuli used (categorised in to three groups of valence: Positive, neutral and negative). - Different tones used for 'R' and 'F' instruction rather than an actual cue. - Recognition task. **Results:** - DF effect - Effect is found regardless of emotional content
Bailey & Chapman	When can we choose to forget? An ERP study into item-method directed forgetting of emotional words	2012	**Materials & Procedure:** - Two studies conducted - 160 words (positive, neutral & negative) - Recall task first as well as a recognition task. **Results:** - DF effect

			-Higher arousal words recalled better than lower - Less DF for emotional content than neutral. - Positive words recalled more, then negative and followed by neutral.
Lee & Lee	Divided attention facilitates intentional forgetting: Evidence from item-method directed forgetting	2011	**Materials & Procedure:** - Two experiments conducted - One is free recall task and other cued recall task. - 42 character Chinese words for first experiment and for second experiment 40 paired words. **Results:** **-** DF effect in both long and short delays - Found retention of Forget stimuli increased as the post-cue interval increased
Orghian, Garcia Marques, Marques & Braga	Memory and conceptual learning of relevant and non-relevant items in item-method directed forgetting	2017	**Materials & Procedure:** - Used two colours of stimuli, were told to focus on one and not the other. - Stimuli was schematic faces - Recognition task **Results:** - DF effect was found
Ahmad, Tan &Hockley	Directed forgetting for categorised pictures: recognition memory for perceptual details versus gist	2019	**Materials & Procedure:** - Three experiments - Used pictures of scenes and objects either perceptual detail or gist - Recognition tasks **Results:** **-** DF effect - Scene and object recognition higher within perceptual detail than gist.

Appendix 15- Ethic Forms for each experiment

Experiment 1-

ETHICS APPLICATION FORM:
PSYCHOLOGY, HEALTH, SOCIAL WORK & SOCIAL CARE

1. Please enter your surname and first name below. (SURNAME, FIRST NAME)
Ahmed, Sumera

2. Please enter your University e mail address (e.g. M.Name@wlv.ac.uk)
[e-mail address redacted]

3. Please enter the name of your Project Supervisor, Director of Studies, or Principal Investigator.
Dr. Tom Mercer, Dr. Danny Hinton and Dr. Richard Darby

4. Please enter date by which a decision is required below. (Note that decisions can take up to 4 working weeks from date of submission)
Within four working weeks of submission

5. Which subject area is your research / project located?
Health and Wellbeing (including Psychology)

6. Please select your Faculty, Department or Research Centre
Faculty of Education Health and Wellbeing

7. Does your research fit into any of the following security-sensitive categories? (For definition of security sensitive categories see RPU webpages (www.wlv.ac.uk/rpu) follow links to Ethical Guidance).

Not applicable

8. Does your research involve the storage on a computer of any records, statements or other documents that can be interpreted as promoting or endorsing terrorist acts?

2. NO

9. Might your research involve the electronic transmission (eg as an email attachment) of any records or statements that can be interpreted as promoting or endorsing terrorist acts?

NO

10. Do you agree to store electronically on a secure University file store any records or statements that can be interpreted as promoting or endorsing terrorist acts. Do you also agree to scan and upload any paper documents with the same sort of content. Access to this file store will be protected by a password unique to you. Please confirm you understand and agree to these conditions?

YES I understand and agree to the conditions

11. You agree NOT to transmit electronically to any third party documents in the University secure document store?

YES I agree

12. Will your research involve visits to websites that might be associated with extreme, or terrorist, organisations? (for definition of extreme or terrorist organisations see RPU webpages (www.wlv.ac.uk/rpu) and follow links to Ethical Guidance.

NO

13. You are advised that visits to websites that might be associated with extreme or terrorist organisations may be subject to surveillance by the police. Accessing those sites from university IP addresses might lead to police enquiries. Do you understand this risk?

YES I understand

14. What is the title of your project?

The impact of emotion on Directed Forgetting

15. Briefly outline your project, stating the rationale, aims, research question / hypothesis, and expected outcomes.

This project intends to look at intentional forgetting in relation to emotion and stimuli of different valences.

Memory regulates day to day activities where processes that are involved in memory retrieval need to work correctly in order for a healthy mindset. It is on the basis of correct consolidation and correct encoding that a memory will be successfully retrieved later on (Frankland, Kohler &Josselyn, 2013). Any fault during encoding or consolidation will lead to 'forgetting'. This concept explains why people often fail to remember a specific memory regardless of how much they try (Frankland et al., 2013). However, this brings on a negative connotation for memory which is not always true. An example of this is 'intentional forgetting' where intentionally forgetting something doesn't necessarily mean a failure of memory, rather it becomes a way of ensuring that relevant information is remembered without interference produced by irrelevant or outdated information (Bjork, 1970; Fawcett & Taylor, 2008).

Another name for this concept of intentionally forgetting is 'Directed Forgetting'. Directed forgetting works by separating the two apparent information types in memory from relevant to irrelevant, and this separation regulates the procedure of correct encoding and later correct retrieval of the appropriate memory (Sahakyan& Foster, 2009). To focus on this further it is of utmost importance that attention is turned to the work of Bjork (1970) and his definition of 'Directed Forgetting'. Bjork (1970) created a Directed Forgetting (DF) paradigm in which the concept of intentional forgetting was further researched. The paradigm itself is split into two core methodologies; the item method and the

list method. The item method works by presenting cues after each stimuli and the list method works by presenting a whole list of stimuli such as a list of words followed by a cue.

Both type of methods use a 'To Be Remembered' (TBR) cue and a 'To Be Forgotten' (TBF) cue. The cues prompt the individual to focus on the instruction and then apply that instruction to the information being studied. Both these cues have been shown to correspond with specific neuronal structures respectively (Wylie, Fixe &Taylor, 2008).

Furthermore, research within the DF paradigm has been broken down even more so as literature within the next area of stimuli is hugely divided. It has been suggested that emotionality is one area that has an impact on forgetting a memory. Research has suggested that the contributory value of emotional stimuli or material can influence the way an individual remembers an event, and in terms of the DF paradigm it has shown to have a strong role. Evidence for this points to the concept of emotionally valenced stimuli or material being less prone to DF effects in comparison to neutrally valenced stimuli (Hamann, 2001). Additional support comes from studies such as Barnier et al. (2007) who also argues that emotional memories are harder to forget in comparison to neutral memories. This may be the result of the close connection between emotion and its importance in evolutionary advantages for survival purposes (Damasio,2001) or down to the relationship between cognition and emotion (Dolan, 2002)

However the division for this is apparent when the stimuli is further broken down within the line of positive, negative and neutral stimuli. On one hand it is argued that negative material is more likely to be remembered (the 'negative bias'; Cacioppo & Gardner, 1999), where negative material is likely to induce a higher physiological response in comparison to positive material (Taylor, 1991). This may be due to the advantage of higher attention given to negative material (Pratto & John, 1991). This has been further supported within DF where a study found a higher DF effect for neutral images in comparison to negative images (Hauswald et al., 2010). However, it has also been argued that there is no such difference in DF when comparing the individual sets of stimuli (Tolin et al., 2002). Conversely, some research has produced results that are on the other end of the spectrum by concluding that negative memories are more likely to be intentionally forgotten in comparison to neutral memories (Brandt, Nielsen & Holmes, 2013). Thus the literature on this area is widely inconsistent in its findings.

Lastly, another factor that plays an important part in memory and forgetting is time, as some research has suggested that unneeded information and the burden of such information lessens over time, which is known as 'active decay' (Hardt, Nader &Nadel, 2013). In terms of actually testing this, Cowan, Beschin and Della Sala (2004) found that there was better recall when there was no time delay before recall as opposed to when there was a time delay. Thus cementing this idea that it takes time to remove irrelevant information (Mercer & Duffy, 2015). In terms of putting this in context of DF this may paint a different perspective overall as it could change the relation between intentional forgetting, emotional stimuli and recall. Therefore time will be another element that will be added within this experiment.

In consideration of the previously discussed research it is imperative that directed forgetting be looked at against the context of emotional stimuli with all three valences; negative, neutral and positive stimuli in the form of words. To test out this theory, this experiment will focus on DF and how emotional words will affect recall especially when there is a time delay between the presentation of each cue and the preceding word. An Item method will also be used to explore the relation of cue and recall. Thus in relation to all this the following hypotheses will be tested:

H1) Participants will show higher recall for words associated with TBR cues than words associated with a TBF cue.
H2) Participants will have a better recall for more emotionally valenced words in comparison to recalling neutrally valenced words.
H3) Participants will also show more recall for negatively valenced words in comparison to positively valenced words.
H4) Participants will show effect for the time delay length where participants will be more likely to recall words when there is less of a time delay in comparison to when there is a larger time delay.
H5) Participants will be more likely to recall emotionally valenced words when there is a TBF cue associated as compared to when the TBF cue is shown for neutrally valenced words.

H6) Participants will be more likely to recall the emotionally valenced words when there is a larger time delay in comparison to recalling the neutrally valenced words.

16. How will your research be conducted?
Describe the methods so that it can be easily understood by the ethics committee. Please ensure you clearly explain any acronyms and subject specific terminology. Max 300 words

Research Design Approach
This will be an experimental study which will be using a repeated measures design.

Recruitment
The study will recruit psychology undergraduate students to take part through opportunity and volunteer sampling. The use of the University's SONA website will primarily be used to collect participants. However, if numbers are low then invitations to take part in the study may also be sent by emails or by advertising personally in classes to gain participants. There will be a minimum of 50 participants for this study.

Materials and procedure
Participants will arrive in the designated room where they will be seated and handed participant sheets such as the information sheet (See Appendix 1) which will then be followed by a consent form (See Appendix 2).This will have to be signed in order for further participation. A demographics questionnaire (See Appendix 3) will also be given to obtain sample information. After this the researcher will use SuperLab which will show the participant 96 words which have all been equally divided within valence, time gap and word length (See Appendix 4). Each word will be proceeded by a cue which will be shown for 1.5 seconds which will then be followed by a time delay of either 0.5 seconds or 10 seconds (See Appendix 5 and Appendix 6). After all the words have been shown, participants will be asked to recall as many words as they can on a recall sheet (See Appendix 7). This will then lead on to the end of the study which will be signified by the handing of the debrief sheet (See Appendix 8) to the participant.

Data Analysis

The data will then be analysed through SPSS (V.20; 2014) which will then lead on to a repeated measures ANOVA being performed to look at the interaction of the three variables.

17. Is ethical approval required by an external agency? (e.g. NHS, company, other university, etc.)

NO

18. What in your view are the ethical considerations involved in this project? (e.g. confidentiality, consent, risk, physical or psychological harm, etc.) Please explain in full sentences. Do not simply list the issues. (Maximum 1000 words)

In this study though ethics have been fully considered and though care has been maintained in order to have the study presented in a careful manner there are still some considerations thatneed to be brought to attention. Firstly, it is the use of deception that takes place. The study demands a slight form of deception to take place as the study is looking at memory. This form of deception is where participants will be told that they need to remember just the 'To Be Remembered' words whereas in fact they will be asked to recall words from both 'To Be Remembered' and 'To Be Forgotten' categories. This deception, however, has been fully explained in the debrief sheet (See Appendix 8) which fully outlines and explains the nature of the study, what actually happened and what was expected of them as participants. If after the debrief sheet (See Appendix 8) is given the participant feels unhappy with the procedure, then they can ask to have their data removed. The right to withdraw has been explained in the information sheet (See Appendix 1) and the debrief sheet.(See Appendix 8)

Another aspect to consider is informed consent (See Appendix 2).Due to the deception taking place, the participants will not be fully able to give their consent. However, once again the full details of the study will be given within the debrief sheet (See Appendix 8) and participants will also be given chances to withdraw if they cannot fully commit. Furthermore, any information that will be provided within the information sheet (See Appendix 1) will not be inaccurate as the procedure will undoubtedly remain the same as participants are just remembering and recalling words.

In terms of the actual experiment, the words being used for participants are 'everyday' words that are dealt within a daily basis (See Appendix 4). These words will be divided amongst the three valences 'positive, negative and neutral' and categorised according to their type. These words will be memorised by participants and may evoke feelings that are representational of their meaning that may cause some displeasure for the individual. However, this has been dealt with by explaining the concept of the words in the information sheet (See Appendix 1) and reiterating it in the informed consent form (See Appendix 2) whereon without giving their fully understood consent participants will not be able to continue. Not only this but as a precaution if the participants feel the need for counseling then they may use the University's Counseling Service where the details have been printed on the debrief sheet (See Appendix 8) alongside contact details of the researcher. However once again if the participant feels uncomfortable at any point then they may withdraw from the study (as mentioned in the information sheet [See Appendix 1] , informed consent sheet [See Appendix 2] and debrief sheet [See Appendix 8])

Lastly looking at the issue of confidentiality, participants will be asked to write words on a word recall sheet (See Appendix 7) which has the risk of being lost, misplaced or the participant being identified. Thus to avoid any of the mentioned issues, all participant related material will be kept in a safe place where only researcher and supervisors will have access. Additionally any raw data collected will also be kept on a password protected computer which once again will only be accessed by the researcher and supervisors. In relation to this participant sheets such as the consent forms (See Appendix 2) and the task recall sheets (See Appendix 7) will be kept separately which eliminates the risk of the participant being identified.

19. Have participants been/will participants be, fully informed of the risks and benefits of participating and of their right to refuse participation or withdraw from the research at any time?

YES (Outline your procedures for informing participants in the space below).

Participants will be handed an information sheet (See Appendix 1) which will inform them about the study. The sheet will look at information such as who is doing the study, what will happen and so on. An important part of this information sheet (See Appendix 1) will be its instructions in regards to the study. Specifically, it will outline the importance of understanding the study and how there will be some minor risks involved and advantages. The benefits will include being awarded SONA credits as well as general understanding of the topic. The other highlighted issue within the information sheet (See Appendix 1) is the risks that will potentially include being exposed to words that will have a negative connotation in their meaning which will have the risk of evoking feelings in association with those negative words (See Appendix 4). However it has also been stressed as to how these are everyday words and shouldn't be of a big concern for the participant.

Additionally, it has been explained in the Information sheet (See Appendix 1) that if the participant will still feel that the exposure to the words is still too much for them then they will be allowed to withdraw at any time. This will be possible up until the participant has completed the experiment as locating single data after that becomes impossible due to the anonymous nature of data collected (also explained within the information sheet [See Appendix 1]). If the participant does decide to withdraw then from that point no data of theirs will be proceeded with.

A consent form (See Appendix 2) will also be issued to each participant which will once again highlight important issues within the study, where participants will give their full consent for the study by signing the sheet as it will be the only means of participation as this will point out that the participant fully understands the study and any risks involved.

After the completion of the study, participants will also be handed a debrief sheet (See Appendix 8) which will present the actual nature and intent of the study. This debrief sheet (See Appendix 8) will highlight and make the participant fully aware of any problems they may have encountered within the study as well as highlighting any deceit that may have occurred. In this study the debrief (See Appendix 8) will highlight how the actual procedure of the experiment was to remember and recall words from both the 'To Be Remembered' and 'To Be Forgotten' (See Appendices 4, 5 & 6) associated words as opposed to what they were told initially which was to remember the 'To Be Remember' words only (See Appendices 4, 5 & 6). The debrief (See Appendix 8) will also reiterate the participants right to withdraw and reassure the participant on the anonymous and confidential

nature of the experiment and data collected. Additionally, the debrief (See Appendix 8) will hold details on the University's counselling services and how the participant can go about contacting them if there was a need of counselling after the experiment in general or due to some of the negatively valenced words shown (See Appendix 4).

20. Are participants in your study going to be recruited from a potentially vulnerable group? (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of vulnerable groups)

NO

21. How will you ensure that the identity of your participants is protected (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for guidance on anonymity)

The data produced within this experiment and study will protect participant identities and anonymity by ensuring that there is no direct or clear link from data to participant. This will be done by participants not giving out identification means through names or any other information.

22. How will you ensure that data remains confidential ((See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of confidentiality)

Confidentiality will be maintained throughout the experiment as there will be no sharing of data to anyone or third parties. Individuals with access to the confidential information will include the researcher and the supervisor(s). However, this will also be limited as all digital data will be processed and saved on a password protected computer and raw data will be kept in a room that is locked.

23. How will you store your data during and after the project? (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of and guidance on data protection and storage).

During the project all information and data will be safely stored where the storage and handling of digital data will be on a password protected computer and the rest of the raw data to be stored safely in a room that is locked and only accessible to the researcher and supervisor(s) where no unauthorised individual may access this data. The period of storage for such data and documents is for the duration of the PhD, whereon after all the data will be destroyed confidentially. It is also of importance to mention that there is a possibility of the results being published if they are considered viable.

24. Append study documentationto this form (Please append below the materials you will use to carry out your study. These should typically include letters of contact, consent forms, information sheets, data collection materials (e.g. interview schedules, surveys, experimental materials, training and intervention materials etc.), debrief and, if appropriate, a risk assessment document/lone worker policy.)

Experiment 2-

ETHICS APPLICATION FORM:
PSYCHOLOGY, HEALTH, SOCIAL WORK & SOCIAL CARE

1. Please enter your surname and first name below. (SURNAME, FIRST NAME)
Ahmed, Sumera

2. Please enter your University e mail address (e.g. M.Name@wlv.ac.uk)
[e-mail address redacted]

3. Please enter the name of your Project Supervisor, Director of Studies, or Principal Investigator.
Dr. Tom Mercer, Dr. Danny Hinton and Dr. Richard Darby

4. Please enter date by which a decision is required below. (Note that decisions can take up to 4 working weeks from date of submission)
31/12/16

5. Which subject area is your research / project located?
Health and Wellbeing (including Psychology)

6. Please select your Faculty, Department or Research Centre
Faculty of Education Health and Wellbeing

7. Does your research fit into any of the following security-sensitive categories? (For definition of security sensitive categories see RPU webpages (www.wlv.ac.uk/rpu) follow links to Ethical Guidance).

Not applicable

8. Does your research involve the storage on a computer of any records, statements or other documents that can be interpreted as promoting or endorsing terrorist acts?

2. NO

9. Might your research involve the electronic transmission (eg as an email attachment) of any records or statements that can be interpreted as promoting or endorsing terrorist acts?

NO

10. Do you agree to store electronically on a secure University file store any records or statements that can be interpreted as promoting or endorsing terrorist acts. Do you also agree to scan and upload any paper documents with the same sort of content. Access to this file store will be protected by a password unique to you. Please confirm you understand and agree to these conditions?

YES I understand and agree to the conditions

11. You agree NOT to transmit electronically to any third party documents in the University secure document store?

YES I agree

12. Will your research involve visits to websites that might be associated with extreme, or terrorist, organisations? (for definition of extreme or terrorist organisations see RPU webpages (www.wlv.ac.uk/rpu) and follow links to Ethical Guidance.

NO

13. You are advised that visits to websites that might be associated with extreme or terrorist organisations may be subject to surveillance by the police. Accessing those sites from university IP addresses might lead to police enquiries. Do you understand this risk?

YES I understand

14. What is the title of your project?

Intentional forgetting and emotionality

15. Briefly outline your project, stating the rationale, aims, research question / hypothesis, and expected outcomes.

This project will further elaborate on Directed Forgetting (DF), emotion and the relation with stimuli based on the List Method of DF.

'Forgetting' is usually a concept of memory that looks at irrelevant information and how it is pushed out of awareness unintentionally (Anderson &Hanslmayr, 2014). Research supports the concept of unintentionally forgetting information as well as intentionally forgetting information. It has been suggested that to retain any information there needs to be some motivational factors (Anderson & Hanslmayr, 2014). Conversely, 'motivational forgetting' is the process that actively works to remove unwanted memories. This idea of intentional forgetting is further built up through 'Directed Forgetting' which works by separating information based on its use of relevance in order to retrieve the correct memory later on based on its appropriateness (Sahakyan & Foster, 2009).

Directed Forgetting was originally a concept that was developed by Bjork (1970) who used it to understand the concept of intentional forgetting through two core methods: The Item method and the List Method. The Item Method is normally based on a stimulus followed immediately by a cue, whereas the List Method works by presenting a block of stimuli and then the relevant cue (‘remember’ or ‘forget’). The results based on these two methods also vary. Whereas the List Method generates results on recall tasks and its effects, the Item Method works by producing results on recall and recognition tasks (Bailey & Chapman, 2012). The List Method has been known to produce effects that are distinct from those of the Item Method (Baddeley, Eysenck & Anderson, 2015) as in this method participants will be less likely to use 'shallow encoding' as there is no prior hint on what

should be remembered and what shouldn't. Not only this, but the results from the List Method are more likely to leave a mark when implicit memory is tested (Baddeley, Eysenck & Anderson, 2015). Additionally unlike the Item Method, the List Method provides evidence for reduced accessibility of the item at that time (Bjork and Bjork ,2003; Baddeley, Eysenck & Anderson, 2015). Therefore, a list method will be used within this current experiment.

In terms of the cues being used (To Be Remembered – TBR and To Be Forgotten – TBF), it is essential to understand that these are used for both of the above methods. Participants are usually led to believe that they will remember just the 'TBR' words but in reality they are always asked at the end to recall words associated with both cues (Bailey & Chapman, 2012). Research has suggested that stimuli associated with the TBR and TBF cues are rehearsed separately (Bjork, 1972). Evidence for this comes from neurological studies that use Event-Related Potential (ERPs) to measure electrical waves that occur in the brain when a stimulus is shown (Rugg, 2009). Further examples of this difference comes from studies that have shown that instructions such as 'forget' produce a mechanism that stops the processing of preceding stimuli in comparison to when a 'remember' cue is shown (Yang et al., 2012). This indicates how these two cues play a vital role in the DF paradigm.

Additionally the DF paradigm is not complete without the use of appropriate stimuli, which could be either words or pictures (Ochsner, 2000; Yang et al., 2012). It has been further argued that emotional stimuli have different impacts on recall where their level of importance or significance seems to play a strong role. The literature within this field is also divided respectively amongst emotional and neutral valence, where on one hand it has been considered that an emotional stimulus is less likely to be prone to DF effects in comparison to neutral information (Hamann, 2001) as emotional information is less likely to be forgotten (Barnier et al., 2007). Reasons for this range from evolutionary processes (Damasio, 2001) to general cognitive regulation with emotion (Dolan, 2002). Consequently, this area can be further broken down from being 'emotional' stimuli to 'positive, neutral and negative' stimuli, where results are definitely varied and divided. Where some research suggests that negative information will be remembered more than positive stimuli due to a 'negative bias' (Cacioppo & Gardner, 1999), there is a chance of negative information having a lower DF effect (Hauswald, Schulz, Iordanov & Kissler, 2010). Others have argued that rather it is positive information that is remembered more due to its 'positive bias' (Baddeley, Eysenck & Anderson, 2015; Walfogel, 1948). This shows the division within the literature on this topic.

Another constraint that has an impact on forgetting and recall is time itself where time seems to affect how much information is remembered. Some research suggests that irrelevant information is removed over time as part of an 'active decay' process (Hardt, Nader & Nadel, 2013). Whilst this may be true, research has also acknowledged as to how there needs to be a sufficient amount of time for this to occur (Mercer & Duffy, 2015). This can be seen in terms of handling and encoding the words 'remember' rather than the 'forget' words. Further to this it has been suggested that emotional or negative information will be more likely to have an enhanced consolidation regardless as to how much time passes (Wang, 2015).

Therefore, in consideration with the literature above and the inconsistencies surrounding the results within the literature it is of importance to study these constraints in order to understand the effect of time, valence and cue in terms of intentionally forgetting. It is also of importance to understand how the List Method of DF works and how it differentiates from the Item Method. Therefore, the hypotheses being tested will be:

H_1: Participants will be able to recall more words that are associated with the TBR cue as opposed to the words that are associated with the TBF cue.
H_2:) Participants will be likely to recall more of the emotionally valenced words in comparison to the neutrally valenced words.
H_3) Participants will recall more of the words that are negatively valenced in comparison to recalling the words that are positively valenced.
H_4) Participants will be more likely to recall words if they are in the 'no time delay' condition as compared to those in the 'time delay' condition where they will be less likely to recall words.
H_5) Participants will be more likely to recall words that are emotionally valenced from the 'TBF' cue list in comparison to the neutrally valenced words that are associated with the 'TBF' cue list.
H_6) Participants will be more likely to recall the emotionally valenced words when there is a time delay in comparison to recalling the neutral words.

H_7) Participants in the 'Forget' condition will also be more likely to recall the second half of the list better in comparison to the 'remember' condition.

16. How will your research be conducted?
Describe the methods so that it can be easily understood by the ethics committee. Please ensure you clearly explain any acronyms and subject specific terminology. Max 300 words

This experiment will use a mixed design with undergraduate University students. They will be recruited through opportunity and volunteer sampling and by using the snowball effect. The University's SONA system will be used alongside advertisements in classes and hall as well as emails. 100 participants will be recruited (25 per group).

Materials and procedure
Participants will be seated in a room where they will be handed an information sheet (Appendix 1 and 2), followed by a consent form (Appendix 3). Signing this form will be the only way to participate in the study. Participants will then complete a demographics questionnaire (Appendix 4) on their age and sex. They will then be allocated to one of the four conditions; 'Remember/delay', 'Remember/ no-delay' (control conditions) and 'forget /delay' or 'forget no/delay' (experimental conditions). Forty-eight words (Appendix 5) will be shown through SuperLab. The same list of words will be arranged in two halves for all conditions. For the experimental conditions, participants will be shown the first half of the list with a TBF cue at the end (Appendix 6) and will be told that it is actually a practice trial which they must forget. After the second half of the list participants will be shown a TBR cue and asked to remember these words (Appendix 7). For the control conditions however, participants will be shown TBR cues (Appendix 7) after both halves and would be told to remember both lists.

Then participants will be asked to recall ALL words on a recall sheet (Appendix 8), regardless of cue. The only difference will be whether they are asked to recall straight away (no delay conditions) or after a break of 8 minutes (delay conditions). A debrief sheet will then be handed to signify the study's end (Appendix 9).

17. Is ethical approval required by an external agency? (e.g. NHS, company, other university, etc.)

NO

18. What in your view are the ethical considerations involved in this project? (e.g. confidentiality, consent, risk, physical or psychological harm, etc.) Please explain in full sentences. Do not simply list the issues. (Maximum 1000 words)

Ethics have been fully considered within this study to ensure that the study runs smoothly albeit with some considerations which will be explained below:

Firstly the use of stimuli which will include words that are divided amongst the following valences: negative, neutral and positive (See appendix 5). Though classed as 'everyday' vocabulary that are used commonly, they still have the chance of evoking feelings that are parallel to their meaning as they will be remembered by the participant. This could lead to feelings of being uncomfortable and feelings of displeasure. However, this has been dealt with by explaining the use of the words and their role within the study in the information sheets (See appendix 1 and 2). Furthermore, participants will only be able to carry on with the study once they go through the informed consent page (See appendix 3) and sign it to take part in the study. Only by doing this and fully understanding these aspects will the participant be able to carry on. Additionally if participants still feel that they cannot continue with the study at any point due to these words then they may withdraw as stated in the information sheets (See appendix 1 and 2), the consent form (See appendix 3) and the debrief sheet (See appendix 9). Participants may also choose to make use of the University's Counselling Services and their details left on the debrief sheet (See appendix 9). In addition, the researchers' contact details have also been added to both the debrief (See appendix 9) and information sheet (See appendix 1 and 2) which the participant may also use to contact the researcher about any other problems or queries.

Also the experiment being a memory study will use deception. Although not huge, it is still something to be considered. This deception will happen in the first condition when the participant will be shown

the first half of the word list and then told this is a practice run where they will need to forget and remember just the second half of the list. However, in reality they will be asked to remember words from both sets. To counter this deception, details and advice have been given through the debrief sheet (See appendix 9) which will explain and elaborate on the study and its nature.

Furthermore, another consideration which ties in with the above is the issue of informed consent due to the slight deception taking place. As participants aren't fully aware of the nature of the study at first, they cannot fully give their consent. However, once again the details about the study and the full explanation will be given in the debrief sheet (See appendix 9) as well as being given the chance to withdraw from the study if they still feel hesitant to continue. Furthermore, the majority of the information given in the information sheet (See appendix 1 and 2) will not be inaccurate as it will still highlight major components and the procedure itself will not be altered as participants will be recalling words that they have memorised.

This then brings on the issue of confidentiality. As participants will be recalling words on a 'recall sheet' (See appendix 8) there is a chance that such loose sheets which includes other participant sheets such as the information sheet (See appendix 1 and 2), consent form (See appendix 3) and debrief sheet (See appendix 9) may be mishandled or lost which could lead to the participant being identified. Thus for security measures all these sheets will be kept in a secure room where only the researcher and the supervisors will have access. As well as this the consent form (See appendix 3), recall sheet (See appendix 8) and demographics (See appendix 4) will all be kept separately to avoid any chances of participants being identified.

19. Have participants been/will participants be, fully informed of the risks and benefits of participating and of their right to refuse participation or withdraw from the research at any time?

YES (Outline your procedures for informing participants in the space below).

To tackle the issues of participants' rights, the participants will all be given an information sheet (See appendix 1 and 2) that will highlight aspects of the study such as what will happen, who is taking part and so on. This information sheet (See appendix 1 and 2) will hold instructions for the participant that will outline the study in general as well as the advantages (SONA credits being awarded as well as contributing towards gaining knowledge on the subject) and disadvantages (being exposed to words with negative meanings that may evoke similar feelings in the participant). Concerns such as the negative words will be explained in terms of their role in the study and how they are everyday words that shouldn't in general cause any problems.

In addition to this the right to withdraw has also been mentioned in the information sheet (See appendix 1 and 2), the consent form (See appendix 3) and the debrief sheet (See appendix 8). If participants feel uncomfortable at any point during the study they can withdraw. However, this is only possible until the actual collection of participant sheets and the end of the experiment as afterwards it becomes impossible to single out any data due to the anonymity of it. If the participant decides to withdraw then their data will not be proceeded with and will be destroyed.

A consent form (See appendix 3) will also be handed to participants, which will highlight and reiterate important points of the study that the participant needs to know in order to carry on or take part in the study itself. Only by signing and giving their full consent will they proceed with the study where without giving this consent participants will not be allowed to continue. The informed consent (See appendix 3) will be a means of fully comprehending risks involved and any other issues that the participant should be aware of.

Once the study is complete, the participants will be given a debrief sheet (See appendix 9) so that they fully understand the nature of the study. The debrief sheet (See appendix 9) will explain every aspect of the study, including any deception or problems they may have encountered. An example would be to highlight how the study was actually looking at words remembered from both sets of cues 'To Be Remembered' (See appendix 7) and 'To Be Forgotten' (See appendix 6) rather than what they were told initially about remembering just the 'To Be Remembered' words (See appendix 5, 6, 7 and 8). The debrief (See appendix 9) will also serve as means to highlight the participants right to withdraw where after finding out the true intent of the study the participant feels unable to further commit then they may withdraw. Furthermore, the debrief (See appendix 9) will hold contact details for the university's counselling Services and contact details for the researcher.

20. Are participants in your study going to be recruited from a potentially vulnerable group? (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of vulnerable groups)
NO

21. How will you ensure that the identity of your participants is protected (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for guidance on anonymity)
Participants will be protected and anonymity will be ensured by making sure that there will be no direct link from participant to data and ensuring that participants will not give out any information or identifying information that will be a cause of concern in terms of identification.

22. How will you ensure that data remains confidential ((See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of confidentiality)
Confidentiality will be followed throughout the experiment by ensuring that there is no access by unauthorised individuals where only the researcher and supervisors will have access to documents and data. Additionally the digital data will be stored on a password-protected computer and raw data will be kept within a locked room, which will obstruct and stop any mishandling of data or unnecessary handling of data.

23. How will you store your data during and after the project? (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of and guidance on data protection and storage).
Any data collected within this experiment will be safely stored and handled. Any hard copies of data or raw data will be kept in a room that is locked and only available to the researcher and supervisors. In terms of the digital data it will be stored on a password-protected computer, which once again will not be accessed by anyone else, except for the researcher or supervisors. All this data will be kept until the completion of the PhD where there is a possible chance of it being published if the data is viable. After this the data will be destroyed securely and confidentially.

24. Append study documentation to this form (Please append below the materials you will use to carry out your study. These should typically include letters of contact, consent forms, information sheets, data collection materials (e.g. interview schedules, surveys, experimental materials, training and intervention materials etc.), debrief and, if appropriate, a risk assessment document/lone worker policy.)

*Changes in the methodology for the experiment titled *' Intentional Forgetting and Emotionality'.*

There are a few changes within this experiment from the last time the Ethics Form was submitted. The experiment itself remains intact, but there are changes within the actual procedure of the experiment as it will now be adapting the methodology of the previous experiment that was titled '*The impact of emotion on Directed Forgetting*'. In the current experiment, rather than having the cue after a whole list of words, the cue will now be presented after each word. The stimuli itself will remain the same as first proposed (Refer to Appendix 1). These words are now divided between two sets where they will alternate in regards to cue, in the experiment half of the participant set will have Block A set with a TBR cue and Block B as a TBF, whilst the other half will have the alternative method of Block A being preceded with a TBF cue and Block B with a TBR cue (Appendix 1).

Additionally, instead of having two conditions (no delay and delay) the experiment will now take a more of a within groups design where there will be only one set of participants that will be subjected to short delays and long delays within the one condition.

Experiment 3a-

Ethics Submission Form 2018
Faculty of Education, Health and Well-being

- *You must complete all sections of this form in as much detail as possible. (word counts are given if necessary) If your form is incomplete, it will be returned to you to resubmit.*
- *You must be given approval for your research project from the University before you can begin.*
- *Applications should be submitted by 1st Monday of each month to FEHWResearch@wlv.ac.uk*

SECTION ONE

1. Enter Your First Name and Surname Below:	
First Name	Ahmed
Surname	Sumera

2. Enter your University Student/ Number
1208623

3. Enter your University e mail address (e.g. M.Name@wlv.ac.uk)
[e-mail address redacted]

4. Enter your daytime contact telephone number in case we need to contact you.
[number recated]

5. Enter the name of your Project Supervisor, Director of Studies, or Principal Investigator.
Dr. Tom Mercer

6. Which subject area is your research / project located? Please ✓ all that apply

		✓
1	FEHW	✓
2	Education	
3	Health	
4	Sport	
5	Psychology	✓
6	FSE	
7	FOSS	
8	FOA	
9	COLT	
10	Cross University Project	
	Other – Please give details below:	

8 Please indicate if this study is	
Staff Research (Externally funded)	
Staff Research (University funded)	

8. Which Category of Project Are You Applying For? Categories are outlined in the handbook from the RPU (www.wlv.ac.uk/rpu) Please tick✓					
Category A	X	Category B		Category 0	

9. Give details of service user involvement

SECTION TWO

10. What is the title of your project?
Valence, Arousal andSex Differences within Directed Forgetting

11. Give details of any proposed research questions/hypothesis
H1) Participants will be able to better recall TBR cue associated words than words that are related to the TBF cue. H2) Participants will be more likely to recall words that are emotional in valence compared to words that are neutral in valence. H3) Participants will be more likely to recall words that are higher in arousal in comparison to the lower arousal words. H4) There will be a higher recall of the negative words from females in comparison to recall of the negative words by the male participants. H5) There will be a more of recall from the higher arousal words within females in comparison to the male participants. H6)Pariticipants will be more likely to recall words that are higher in arousal and are associated with the TBF cue in comparison to those words that are lower in arousal. H7) Participants will recall more words that are emotionally valenced when there is a TBF cue in comparison to recalling neutral words.

12. Briefly outline your project, stating the rationale, aims and expected outcomes. (300 words)
This project intends to further look at intentional forgetting in relation to sex differences, arousal and valence. Forgetting is often considered as something that is a accidental or unintentional, whereas research has shown that forgetting can be intentional too. The concept of intentional forgetting is examined in

more detail through the paradigm of 'Directed Forgetting' or DF (Bjork,1970), which works by telling participants to remember some stimuli (the TBR information) and forget others (the TBF information). In a subsequent memory test, participants are much more likely to remember TBR than TBF stimuli (Sahakyan& Foster, 2009).

However, there are mixed results concerning directed forgetting of emotional stimuli. There is a general dispute concerning what can be intentionally forgotten, and this is down to many factors, sometimes valence itself (Cacioppo&Gardner, 1999). Interestingly, within valence there are many reasons that contribute to whether something is forgotten or not. Some research has put this down to underlying factors such as arousal (e.g. “agitating” stimuli) and it has been argued thatarousalinduced by stimulican even eliminate DF effects (Depue et al., 2006). The reasons as to why arousal can have such an impact is arguable with many reasons influencing how arousal can impact something such as memory. One of thesepotentially maybesex differences and how males and females process emotion differently (Young et al., 2013).

Thus it would be important to test whether arousal and sex differences are prevalent within DF and if there is a difference in how stimuli can be intentionally forgetten when these two factors are integrated within the field of DF in regards to valence and processing.

12. How will your research be conducted? (750 words max.)
Describe the methods so that it can be easily understood by the ethics committee. Please ensure you clearly explain any acronyms and subject specific terminology.

A repeated measures design will be used through an online platform. Participants will be recruited through opportunity and volunteer sampling with a minimum of 50 students required.

As this is an online study, participants will use any medium in which they can access the internet and use the website 'Gorilla'. Hyperlinks and invitations will be given out through email, social media and so on. Firstly, participants will encounter an information page (Appendix 1) which will talk about thethe nature of the study. After clicking next they will be taken to an informed consent page [Appendix 2] which will require the participants to agree to conditions of the study and ensure the participants are aged 18 or over. It will also reiterate any risks and benefits of taking part that the participant would need to know before making their decision. After completing this and clicking next again, a demographics questionnaire [Appendix 3] will be used to gather information about the age and sex of the participant. This will then lead to the actual experiment which will follow the DF paradigm (Bjork, 1970). The experiment will consist of 72 words being shown on their screen from the ANEW database (Bradley & Lang, 1999), divided amongst valence (positive, neutral and negative words) and arousal (high and low [Appendix 4]). These words will be randomised and shown one by one followed by a cue [Appendix 5 & 6], either 'To-Be-Remembered' (TBR) or 'To-Be-Forgotten' (TBF). Based on the cue, participants would be expected to either remember or forget the word. After all the words have been shown, participants will be directed to a recall task page [Appendix 7], which will instruct participants to remember *all* words regardless of cue.Participants will be expected to recall within a maximum time span of five minutes, but if they finish beforehand they may press finish.

At the end of this a debrief sheet [Appendix 8] will be given in regards to the true nature of the study. This will mark the end of the experiment.

13. How will your data be analysed?

Analysis will be done through SPSS using a repeated measures ANOVA.

14. Is ethical approval required by an external agency? (e.g. NHS, company, other university, outside organisation, etc.)

1. NO

15. What in your view are the ethical considerations involved in this project? (e.g. confidentiality, consent, risk, physical or psychological harm, etc.) Please explain in full sentences. Do not simply list the issues. You should also make it clear how you are going to deal with issues with regard to your own welfare and safety.

Areas	✓	Intervention
Confidentiality	✓	Participants will be asked to give demographics [Appendix 3] at the beginning and type in words on a word recall sheet at the end (Appendix 7).To keep data confidential, all participant-related material will be kept on a password protected computer that will be accessed only by the researcher and supervisors. Additionally, no third party will have access to the logins of the website that has stored this information. Additionally, any other raw data collected will also be kept on a password protected computer which once again will only be accessed only by the researcher and supervisors. The software being used – Gorilla - complies with BPS guidelines and regulations. All identifying data such as demographics are stored separately which when downloaded use private IDs, hence there is no chance of identification and anonymity is preserved throughout. Additionally any data collected is owned solely by the researcher, where any deletion of data is permanent and cannot be accessed by third parties. However by no means does this mean that participants cannot withdraw as they are offered this option throughout.
Consent	✓	Due to some mild deception (see below), the participants will not be fully able to give their full consent (See Appendix 2). However, this will all be explained within the debrief page(See Appendix 8) alongside having the opportunity to withdraw. Furthermore, detailswithin the information sheet (See Appendix 1) will explain the procedure which will remain the same as participants are just remembering and recalling words. Additionally, due to being an online study and being available for everyone, it is possible that someone who is under 18 may try to take

		part. This will be avoided by the demographics questionnaire which will only let the participants proceed when they have confirmed that they are of or above the age of 18.
Deception	✓	Though all these ethical issues have been fully considered and though care has been maintained there is a mild form of deception. Here participants will be told that they need to remember just the 'To Be Remembered/TBR' words whereas in reality they will be asked to recall words from both 'To Be Remembered' and 'To Be Forgotten/TBF' categories (See Appendix 4). This deception, however, has been fully explained in the debrief sheet (See Appendix 8), which outlines and explains the real nature of the study. However if after reading the debrief sheet (See Appendix 8) the participant feels unhappy with the study then they may exit from the study by exiting the study and without clicking 'submit'. The right to withdraw has been explained in the information sheet (See Appendix 1) and the debrief sheet(See Appendix 8).
Stimuli	✓	The words being used are 'everyday' words that are used ona daily basis (See Appendix 4), but there may be chances that the participants may feel these words evoke feelings that are representational of their underlying meanings.This may cause some form of displeasure. However, the reason for using these words has been explained in the information sheet (See Appendix 1). Additionally the informed consent form (SeeAppendix 2) has been used to take the participants full consent and give them an understanding as to what they are going to be doing which needs their full consent. Not only this but for precautionary measures the University's Counselling Services details have been listed on the debrief sheet as well as details about contacting participants local GP have been mentioned for those who are out of univeristy premises (See Appendix 8). Additional details of the researcher have also been provided, in case the participant feels the need to use these. However once again if the participant feels uncomfortable at any point then they may withdraw at any point (as mentioned in the information sheet [See Appendix 1], informed consent sheet [See Appendix 2] and debrief sheet [See Appendix 8]).

16. Have participants been/will participants be, fully informed of the risks and benefits of participating and of their right to refuse participation or withdraw from the research at any time?

1. YES (Outline your procedures for informing participants in the space below.)

Participants will be shown an informationpage (See Appendix 1) which will inform them about the study. The sheet will provide information that is related to the study,from the procedure to the reasons behind it. It will also outline any potential minor risks and general advantages of taking part. The information page (See Appendix 1) will also highlight the stimuli and the risk of coming across words with negative connotations. However it has also been stressed that these are everyday words and shouldn't be of any major concern for the participant.

Additionally, it has been explained in the Information page (See Appendix 1) that if the participant feels uncomfortable at any point then they may withdraw at any time before or during data collection. Withdrawal from the participant is onlyallowed up until the point that data is submitted at the end of the experiment due to the anonymous nature of the data. If the participant does decide to withdraw then from that point no data of theirs will be proceeded with.

A consent form (See Appendix 2) will also be issued to each participant which will once again highlight important issues within the study, where participants will give their consent for the study. Ticking and confirming these issues on the page will be the only means of participation as this will ensure that the participant fully understands the study and any risks involved.

After the completion of the study, participants will also be shown a debrief page(See Appendix 8) which will explain the actual intent of the study. The debrief page (See Appendix 8) will generally highlight and explain any problems the participants may have encountered within the study. This will also include explaining why participants had to recall words from both the 'To Be Remembered' and 'To Be Forgotten' list as opposed to initial instructions of remembering just the 'To Be Remembered' words. The debrief (See Appendix 8) will also reiterate the participants right to withdraw and reassure the participant on the anonymous and confidential nature of the experiment and data collected. Additionally, the debrief (See Appendix 8) will hold details of the University's counselling services and suggestions of outside help by suggestions of conatcting their local GP, if need be (See Appendix 8).

17. How will you ensure that the identity of your participants is protected (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for guidance on anonymity)

The data produced within this experiment and study will protect participant identities and anonymity by ensuring that there is no direct or clear link from data to participant. This will be done by participants not giving out identification means through names or any other information.

18. How will you ensure that data remains confidential ((See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of confidentiality)

Confidentiality will be maintained throughout the experiment as there will be no sharing of data to anyone or third parties. Individuals with access to the confidential information will include the researcher and the supervisor(s). However, this will also be limited as all digital data and other scanned hardcopy data will also be processed and saved on a password protected computer.

19. How will you store your data during and after the project? (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of and guidance on data protection and storage).

During the project all information and data will be safely stored where the storage and handling of digital data will be on a password protected computer and only accessible to the researcher and supervisor(s).No unauthorised individual may access this data. The period of storage for such data and documents isfor the duration of the PhD (approximately 3-4 years), whereon after all the data will be destroyed confidentially. Not only this but all or any potential hardcopy material will now be scanned and kept safely on a passsword protected computer. It is also of importance to mention that there is a possibility of the results being published if they are considered viable.

SECTION THREE

The following questions must be answered otherwise your form will not be reviewed and it will need to be resubmitted to the panel at a later date.

20. Does Your Research Involve Children Under 18 years of Age? Please delete and leave your response below
1. No
If Yes, Do you have an Enhanced Disclosure Certificate from the Criminal Records Bureau/Disclosure and Barring Service (DBS)?

21. Are participants in your study going to be recruited from a potentially vulnerable group? (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of vulnerable groups)
2. NO

22. Does your research fit into any of the following security-sensitive categories? (For definition of security sensitive categories see RPU webpages (www.wlv.ac.uk/rpu) follow links to Ethical Guidance). If so please complete questions 22-26

	Security Sensitive Categories	If YES, please tick below. ✓	If NO, please tick below. ✓
1	Commissioned by the military		✓
2	Commissioned under an EU security call		✓
3	Involve the acquisition of security clearances		✓
4	Concerns terrorist or extreme groups		✓

23. Does your research involve the storage on a computer of any records, statements or other documents that can be interpreted as promoting or endorsing terrorist acts? Please delete and leave your response below.
1. NO

24. Will your research involve the electronic transmission (e.g. as an email attachment) of any records or statements that can be interpreted as promoting or endorsing terrorist acts? Please delete and leave your response below.
NO

25.Do you agree to store electronically on a secure University file store any records or statements that can be interpreted as promoting or endorsing terrorist acts. Do you also agree to scan and upload any paper documents with the same sort of content? Access to this file store will be protected by a password unique to you. Please confirm you understand and agree to these conditions.
1. YES I understand and agree to the conditions

26. Do you agree NOT to transmit electronically to any third party documents in the University secure document store?
1. YES I agree

27. Will your research involve visits to websites that might be associated with extreme, or terrorist, organisations? (for definition of extreme or terrorist organisations see RPU webpages (www.wlv.ac.uk/rpu) and follow links to Ethical Guidance.
2. NO

28. You are advised that visits to websites that might be associated with extreme or terrorist organisations may be subject to surveillance by the police. Accessing those sites from University IP addresses might lead to police enquiries. Do you understand this risk?
1. YES I understand

29. Appendices (All submissions) Please list the items that you are submitting with this document. (These will need to be submitted to FEHWResearch@wlv.ac.uk) You may want to include additional information that will help the panel with their decision such as your proposal. Youneed to provide examples of research instruments, recruitment posters and leaflets, information sheets (age appropriate) assent forms (for children), consent forms, risk assessment if research is carried out abroad .

Experiment 3b-

Amendments to the ethics form:

Changes in the methodology for the experiment titled ' *Valence, Arousal and Sex Differences within Directed Forgetting'*.

The study will now be be called ' Valence and Directed Forgetting'.

There is a small change within this experiment from the last time the Ethics Form was submitted. The experiment itself remains intact, but there is a slight changes within the actual procedure of the experiment as it will now be using a cued method of recall in contrast to the previous experiment, where free recall was used. Now participants will be shown each word partially (.i.e. SUM*** or SU****for summer) at the time of recall where they would then have to recall the word based on the cues prompt. Rather than having a blank canvas to free recall whatever they can remember within five minutes. The stimuli itself will remain the same as first proposed, as well as the method of implementation. Please find the previous ethic form attached below.

Ethics Submission Form 2018
Faculty of Education, Health and Well-being

- *You must complete all sections of this form in as much detail as possible. (word counts are given if necessary) If your form is incomplete, it will be returned to you to resubmit.*
- *You must be given approval for your research project from the University before you can begin.*
- *Applications should be submitted by 1st Monday of each month to FEHWResearch@wlv.ac.uk*

SECTION ONE

1. Enter Your First Name and Surname Below:	
First Name	Ahmed
Surname	Sumera

2. Enter your University Student/ Number
1208623

3. Enter your University e mail address (e.g. M.Name@wlv.ac.uk)

[e-mail address redacted]

4. Enter your daytime contact telephone number in case we need to contact you.

[number redacted]

5. Enter the name of your Project Supervisor, Director of Studies, or Principal Investigator.

Dr. Tom Mercer

6. Which subject area is your research / project located? Please ✓ all that apply

		✓
1	FEHW	✓
2	Education	
3	Health	
4	Sport	
5	Psychology	✓
6	FSE	
7	FOSS	
8	FOA	
9	COLT	
10	Cross University Project	
	Other – Please give details below:	

8 Please indicate if this study is

Staff Research (Externally funded)	
Staff Research (University funded)	

8. Which Category of Project Are You Applying For?
Categories are outlined in the handbook from the RPU (www.wlv.ac.uk/rpu) Please tick✓

Category A	X	Category B		Category 0	

9. Give details of service user involvement

SECTION TWO

10. What is the title of your project?

Valence and Directed Forgetting

11. Give details of any proposed research questions/hypothesis

H1) Participants will be able to better recall TBR cue associated words than words that are related to the TBF cue.

H2) Participants will be more likely to recall words that are emotional in valence compared to words that are neutral in valence.

H3) Participants will be more likely to recall words that are higher in arousal in comparison to the lower arousal words.

H4) There will be a higher recall of the negative words from females in comparison to recall of the negative words by the male participants.

H5) There will be a more of recall from the higher arousal words within females in comparison to the male participants.

H6)Pariticipants will be more likely to recall words that are higher in arousal and are associated with the TBF cue in comparison to those words that are lower in arousal.

H7) Participants will recall more words that are emotionally valenced when there is a TBF cue in comparison to recalling neutral words.

12. Briefly outline your project, stating the rationale, aims and expected outcomes. (300 words)

This project intends to further look at intentional forgetting in relation to sex differences, arousal and valence.

Forgetting is often considered as something that is a accidental or unintentional,whereas research has shown that forgetting can be intentional too. The concept of intentional forgetting is examined in more detail through the paradigm of 'Directed Forgetting' or DF (Bjork,1970), which works by telling participants to remember some stimuli (the TBR information) and forget others (the TBF information). In a subsequent memory test, participants are much more likely to remember TBR than TBF stimuli (Sahakyan& Foster, 2009).

However, there are mixed results concerning directed forgetting of emotional stimuli. There is a general dispute concerning what can be intentionally forgotten, and this is down to many factors, sometimes valence itself (Cacioppo&Gardner, 1999). Interestingly, within valence there are many reasons that contribute to whether something is forgotten or not. Some research has put this down to underlying factors such as arousal (e.g. “agitating” stimuli) and it has been argued thatarousalinduced by stimulican even eliminate DF effects (Depue et al., 2006). The reasons as to why arousal can have such an impact is arguable with many reasons influencing how arousal can impact something such as memory. One of thesepotentially maybesex differences and how males and females process emotion differently (Young et al., 2013).

Thus it would be important to test whether arousal and sex differences are prevalent within DF and if there is a difference in how stimuli can be intentionally forgetten when these two factors are integrated within the field of DF in regards to valence and processing.

12. How will your research be conducted? (750 words max.)
Describe the methods so that it can be easily understood by the ethics committee. Please ensure you clearly explain any acronyms and subject specific terminology.

A repeated measures design will be used through an online platform. Participants will be recruited through opportunity and volunteer sampling with a minimum of 50 students required.

As this is an online study, participants will use any medium in which they can access the internet and use the website 'Gorilla'. Hyperlinks and invitations will be given out through email, social media and so on. Firstly, participants will encounter an information page (Appendix 1) which will talk about thethe nature of the study. After clicking next they will be taken to an informed consent page [Appendix 2] which will require the participants to agree to conditions of the study and ensure the participants are aged 18 or over. It will also reiterate any risks and benefits of taking part that the participant would need to know before making their decision. After completing this and clicking next again, a demographics questionnaire [Appendix 3] will be used to gather information about the age and sex of the participant. This will then lead to the actual experiment which will follow the DF paradigm (Bjork, 1970). The experiment will consist of 72 words being shown on their screen from the ANEW database (Bradley & Lang, 1999), divided amongst valence (positive, neutral and negative words) and arousal (high and low [Appendix 4]). These words will be randomised and shown one by one followed by a cue [Appendix 5 & 6], either 'To-Be-Remembered' (TBR) or 'To-Be-Forgotten' (TBF). Based on the cue, participants would be expected to either remember or forget the word. After all the words have been shown, participants will be directed to a recall task page [Appendix 7], here participants will use the help of cued recall where they will have to rememeber all the words regardless of cue. Answers would be expected to be typed with each prompt. Once all the prompts have been shown, participants may finish or exit at any time within this part. At the end of the study a debrief sheet [Appendix 8] will be shown in regards to the true nature of the study. This will mark the end of the experiment.

13. How will your data be analysed?

Analysis will be done through SPSS using a repeated measures ANOVA.

14. Is ethical approval required by an external agency? (e.g. NHS, company, other university, outside organisation, etc.)

1. NO

15. What in your view are the ethical considerations involved in this project? (e.g. confidentiality, consent, risk, physical or psychological harm, etc.) Please explain in full sentences. Do not simply list the issues. You should also make it clear how you are going to deal with issues with regard to your own welfare and safety.

Areas	✓	Intervention
Confidentiality	✓	Participants will be asked to give demographics [Appendix 3] at the beginning and type in words on a word recall sheet at the end (Appendix 7).To keep data confidential, all participant-related material will be kept on a password protected computer that will be accessed only by the researcher and supervisors. Additionally, no third party will have access to the logins of the website that has stored this information. Additionally, any other raw data collected will also be kept on a password protected computer which once again will only be accessed only by the researcher and supervisors. The software being used – Gorilla - complies with BPS guidelines and regulations. All identifying data such as demographics are stored separately which when downloaded use private IDs, hence there is no chance of identification and anonymity is preserved throughout. Additionally any data collected is owned solely by the researcher, where any deletion of data is permanent and cannot be accessed by third parties. However by no means does this mean that participants cannot withdraw as they are offered this option throughout.
Consent	✓	Due to some mild deception (see below), the participants will not be fully able to give their full consent (See Appendix 2). However, this will all be explained within the debrief page(See Appendix 8) alongside having the opportunity to withdraw. Furthermore, detailswithin the information sheet (See Appendix 1) will explain the procedure which will remain the same as participants are just remembering and recalling words. Additionally, due to being an online study and being available for everyone, it is possible that someone who is under 18 may try to take part. This will be avoided by the demographics questionnaire which will only let the participants proceed when they have confirmed that they are of or above the age of 18.
Deception	✓	Though all these ethical issues have been fully considered and though care has been maintained there is a mild form of deception. Here participants will be told that they need to remember just the 'To Be Remembered/TBR' words whereas in reality they will be asked to recall words from both 'To Be Remembered' and 'To Be Forgotten/TBF' categories (See Appendix 4). This deception, however, has been fully explained in the debrief sheet (See Appendix 8), which outlines and explains the real nature of the study. However if after reading the debrief sheet (See Appendix 8) the participant feels unhappy with the study then they may exit from the study by exiting the study and without clicking 'submit'. The right to withdraw has been explained in the information sheet (See Appendix 1) and the debrief sheet(See Appendix 8).
Stimuli	✓	The words being used are 'everyday' words that are used ona daily basis (See Appendix 4), but there may be chances that the participants may feel these words evoke feelings that are representational of their underlying meanings.This may cause some form of displeasure. However, the reason for using these words has been explained in the information sheet (See Appendix 1). Additionally the informed consent form (SeeAppendix 2) has been used to take the participants full consent and give them an understanding as to what they are going to be doing which needs

		their full consent. Not only this but for precautionary measures the University's Counselling Services details have been listed on the debrief sheet as well as details about contacting participants local GP have been mentioned for those who are out of univeristy premises (See Appendix 8). Additional details of the researcher have also been provided, in case the participant feels the need to use these. However once again if the participant feels uncomfortable at any point then they may withdraw at any point (as mentioned in the information sheet [See Appendix 1], informed consent sheet [See Appendix 2] and debrief sheet [See Appendix 8]).

16. Have participants been/will participants be, fully informed of the risks and benefits of participating and of their right to refuse participation or withdraw from the research at any time?

1. YES (Outline your procedures for informing participants in the space below.)

Participants will be shown an informationpage (See Appendix 1) which will inform them about the study. The sheet will provide information that is related to the study,from the procedure to the reasons behind it. It will also outline any potential minor risks and general advantages of taking part. The information page (See Appendix 1) will also highlight the stimuli and the risk of coming across words with negative connotations. However it has also been stressed that these are everyday words and shouldn't be of any major concern for the participant.

Additionally, it has been explained in the Information page (See Appendix 1) that if the participant feels uncomfortable at any point then they may withdraw at any time before or during data collection. Withdrawal from the participant is onlyallowed up until the point that data is submitted at the end of the experiment due to the anonymous nature of the data. If the participant does decide to withdraw then from that point no data of theirs will be proceeded with.

A consent form (See Appendix 2) will also be issued to each participant which will once again highlight important issues within the study, where participants will give their consent for the study. Ticking and confirming these issues on the page will be the only means of participation as this will ensure that the participant fully understands the study and any risks involved.

After the completion of the study, participants will also be shown a debrief page(See Appendix 8) which will explain the actual intent of the study. The debrief page (See Appendix 8) will generally highlight and explain any problems the participants may have encountered within the study. This will also include explaining why participants had to recall words from both the 'To Be Remembered' and 'To Be Forgotten' list as opposed to initial instructions of remembering just the 'To Be Remembered' words. The debrief (See Appendix 8) will also reiterate the participants right to withdraw and reassure the participant on the anonymous and confidential nature of the experiment and data collected. Additionally, the debrief (See Appendix 8) will hold details of the University's counselling services and suggestions of outside help by suggestions of conatcting their local GP, if need be (See Appendix 8).

17. How will you ensure that the identity of your participants is protected (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for guidance on anonymity)

The data produced within this experiment and study will protect participant identities and anonymity by ensuring that there is no direct or clear link from data to participant. This will be done by participants not giving out identification means through names or any other information.

18. How will you ensure that data remains confidential ((See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of confidentiality)

Confidentiality will be maintained throughout the experiment as there will be no sharing of data to anyone or third parties. Individuals with access to the confidential information will include the researcher and the supervisor(s). However, this will also be limited as all digital data and other scanned hardcopy data will also be processed and saved on a password protected computer.

19. How will you store your data during and after the project? (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of and guidance on data protection and storage).

During the project all information and data will be safely stored where the storage and handling of digital data will be on a password protected computer and only accessible to the researcher and supervisor(s).No unauthorised individual may access this data. The period of storage for such data and documents isfor the duration of the PhD (approximately 3-4 years), whereon after all the data will be destroyed confidentially. Not only this but all or any potential hardcopy material will now be scanned and kept safely on a passsword protected computer. It is also of importance to mention that there is a possibility of the results being published if they are considered viable.

SECTION THREE

The following questions must be answered otherwise your form will not be reviewed and it will need to be resubmitted to the panel at a later date.

20. Does Your Research Involve Children Under 18 years of Age? Please delete and leave your response below
2. No
If Yes, Do you have an Enhanced Disclosure Certificate from the Criminal Records Bureau/Disclosure and Barring Service (DBS)?

21. Are participants in your study going to be recruited from a potentially vulnerable group? (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of vulnerable groups)
2. NO

22. Does your research fit into any of the following security-sensitive categories? (For definition of security sensitive categories see RPU webpages (www.wlv.ac.uk/rpu) follow links to Ethical Guidance). If so please complete questions 22-26

	Security Sensitive Categories	If YES, please tick below. ✓	If NO, please tick below. ✓
1	Commissioned by the military		✓
2	Commissioned under an EU security call		✓
3	Involve the acquisition of security clearances		✓
4	Concerns terrorist or extreme groups		✓

23. Does your research involve the storage on a computer of any records, statements or other documents that can be interpreted as promoting or endorsing terrorist acts? Please delete and leave your response below.
1. NO

24. Will your research involve the electronic transmission (e.g. as an email attachment) of any records or statements that can be interpreted as promoting or endorsing terrorist acts? Please delete and leave your response below.
NO

25.Do you agree to store electronically on a secure University file store any records or statements that can be interpreted as promoting or endorsing terrorist acts. Do you also agree to scan and upload any paper documents with the same sort of content? Access to this file store will be protected by a password unique to you. Please confirm you understand and agree to these conditions.
1. YES I understand and agree to the conditions

26. Do you agree NOT to transmit electronically to any third party documents in the University secure document store?
1. YES I agree

27. Will your research involve visits to websites that might be associated with extreme, or terrorist, organisations? (for definition of extreme or terrorist organisations see RPU webpages (www.wlv.ac.uk/rpu) and follow links to Ethical Guidance.
2. NO

28. You are advised that visits to websites that might be associated with extreme or terrorist organisations may be subject to surveillance by the police. Accessing those sites from University IP addresses might lead to police enquiries. Do you understand this risk?
1. YES I understand

29. Appendices (All submissions) Please list the items that you are submitting with this document. (These will need to be submitted to FEHWResearch@wlv.ac.uk) You may want to include additional information that will help the panel with their decision such as your proposal. Youneed to provide examples of research instruments, recruitment posters and leaflets, information sheets (age appropriate) assent forms (for children), consent forms, risk assessment if research is carried out abroad .

Experiment 4- Pilot rating study

ETHICS APPLICATION FORM:
PSYCHOLOGY, HEALTH, SOCIAL WORK & SOCIAL CARE

1. Please enter your surname and first name below. (SURNAME, FIRST NAME)
Ahmed, Sumera

2. Please enter your University e mail address (e.g. M.Name@wlv.ac.uk)
[e-mail address redacted]

3. Please enter the name of your Project Supervisor, Director of Studies, or Principal Investigator.
Dr. Tom Mercer, Dr. Danny Hinton and Dr. Richard Darby

4. Please enter date by which a decision is required below. (Note that decisions can take up to 4 working weeks from date of submission)
30/09/2017

5. Which subject area is your research / project located?
Health and Wellbeing (including Psychology)

6. Please select your Faculty, Department or Research Centre
Faculty of Education Health and Wellbeing

7. Does your research fit into any of the following security-sensitive categories? (For definition of security sensitive categories see RPU webpages (www.wlv.ac.uk/rpu) follow links to Ethical Guidance).

Not applicable

8. Does your research involve the storage on a computer of any records, statements or other documents that can be interpreted as promoting or endorsing terrorist acts?

2. NO

9. Might your research involve the electronic transmission (eg as an email attachment) of any records or statements that can be interpreted as promoting or endorsing terrorist acts?

NO

10. Do you agree to store electronically on a secure University file store any records or statements that can be interpreted as promoting or endorsing terrorist acts. Do you also agree to scan and upload any paper documents with the same sort of content. Access to this file store will be protected by a password unique to you. Please confirm you understand and agree to these conditions?

YES I understand and agree to the conditions

11. You agree NOT to transmit electronically to any third party documents in the University secure document store?

YES I agree

12. Will your research involve visits to websites that might be associated with extreme, or terrorist, organisations? (for definition of extreme or terrorist organisations see RPU webpages (www.wlv.ac.uk/rpu) and follow links to Ethical Guidance.

NO

13. You are advised that visits to websites that might be associated with extreme or terrorist organisations may be subject to surveillance by the police. Accessing those sites from university IP addresses might lead to police enquiries. Do you understand this risk?

YES I understand

14. What is the title of your project?

Pilot rating of concrete/ abstract words

15. Briefly outline your project, stating the rationale, aims, research question / hypothesis, and expected outcomes.

Forgetting is a very important aspect to memory that can be done incidentally (Anderson &Hanslmayr, 2014) or Intentionally (Bjork,1989). Memory that is classed as 'intentional forgetting' is forgotten as an adaptive mechanism, whereas 'incidental forgetting' is seen as a failure of memory. In fact intentionally forgetting stimuli and general memories is an area that is constantly developing and being researched on. This has been mainly done by using the Directed Forgetting Paradigm which has been created by Bjork (1970). The theory of of intentional forgetting is one that revolves around the stimuli being either images (Ochsner, 2000) or words (Dewhurst &Parry, 2000). In regards to successfully forgetting these memories within these studies, it is the stimuli that is considered to have an influence on what can be remembered or in this case forgotten by the individual. However, it is the very use of stimuli that is also questioned within such studies, in regards to whether they hold credibility.

In fact generally speaking, research has looked at stimuli such as words in many forms in contrast with each other to gain results in these tasks. Such is the research based on concrete and abstract words which have been researched within topics such as lexical processing (Schwanenflugel, Harnishfeger & Stowe, 1988), frequency (Galbraith & Underwood, 1973), processing and diagnosed disorders (Crutch, Ridha & Warrington, 2006) and lastly general memory (Walker & Hulme, 1999) and so on. However there seems

to be a dearth of literature that surrounds the impact of these exact words and their relation with memory when they are categorised within valence. This is particularly the case in regards to how they are treated within the act of forgetting or more specifically directed forgetting. Thus to fully understand this, a potential study will be made on these abstract and concrete words to test out the impact of these words within intentional/ Directed forgetting. However, before doing so it is crucial to first categorise these words appropriately within valence (positive, neutral and negative). The only way to do this and use these words appropriately would be by conducting a pilot rating study first, which will use participants to rate words on valence and other related dimensions. Therefore, this pilot rating study will do exactly that. Not only this but mood will also be measured within this pilot study as mood is known to influence feeling states and cognition (Rottenberg, 2005) by modulating emotional reactions (Rosenberg, 1998). Thus it is important to factor in mood too within the ratings of these stimuli to see whether it may have an impact.

This study will be used as a pilot rating study that will build up stimuli to use in a potential study based on concrete and abstract words taken from Paivio, Yuille and Madigan (1968). The words will be rated upon valence and arousal using the Affective slider (Betella & Verschure, 2016) which has been adapted from the Self Assessment Manikin (SAM [Bradley & Lang, 1994]). This will ultimately categorise the words within three valences (positive, negative and neutral) and how high or low they are based on their arousal which would make further analyses in potential studies easier and more reliable. Additionally a mood assessment scale will also be added to asses mood and the impact it may have on the ratings.

16. How will your research be conducted?
Describe the methods so that it can be easily understood by the ethics committee. Please ensure you clearly explain any acronyms and subject specific terminology. Max 300 words

A repeated measures design will be used through an online platform. Participants will be recruited through opportunity and volunteer sampling with a minimum of 20 students and as this is a pilot rating study, the number of participants may decrease or increase depending on need and time.

As this is an online study, participants will use any medium in which they can access the internet and use the website 'Qualtrics'. Hyperlinks and invitations will be given out through email, social media and so on. Firstly participants will encounter an information page (Appendix 1) which will advise them on the nature of what they are doing which is simply to rate words on valence and arousal so that they may be used within a potential future study. This will be followed by a consent page which will reiterate the important nature of these ratings (Appendix 2) whereby participants will fill in to give their consent and take part. After this participants will be given a demographics questionnaire, which will ask participants about the age and sex (Appendix 3). Then by clicking next participants will be given an adapted online version of the Positive and Negative Affect Scale questionnaire (PANAS - Watson, Clark & Tellegan, 1988) to assess their mood (Appendix 4) followed by a presentation of randomised words - either abstract or concrete (160 altogether [Apppendix 5]), where each word would be rated on the Affective slider (Betella & Verschure, 2016). Participants will rate each word based on pleasure and arousal. Once they have completed the task, they will be shown a 'debrief' page (Appendix 6) to understand the reasons behind this pilot rating study. This will mark the end of this study which is expected to take 30 minutes to complete.

17. Is ethical approval required by an external agency? (e.g. NHS, company, other university, etc.)

NO

18. What in your view are the ethical considerations involved in this project? (e.g. confidentiality, consent, risk, physical or psychological harm, etc.) Please explain in full sentences. Do not simply list the issues. (Maximum 1000 words)

Ethics have been fully considered within this short study,however some potential considerations have been explained below:

The words (Appendix 5) may have underlying affective connotations (positive, neutral and negative) which may become more clearer after the study yet will still be fairly identifiable through the study. This could then lead to parallel feelings being identified within participants in line with the words meaning which at times could be uncomfortable or otherwise. However, the stimuli are 'everyday' words that would have been used and experienced on a regular basis. Yet to avoid any problems this will generally be counteracted by explaining these concerns within the information page (Appendix 1) which will be used to identify the role of these words and the importance within the next potential study. Additionally participants may only move forward with the pilot study when they complete the informed consent (Appendix 2) which would be used to reinforce and reiterate important points and considerations of the study.Conjunctively, the debrief sheet (Appendix 6) will also provide the University's Counseling Service and Samaritans contact details in case there become a need for participants to contact these services.Not only this but withdrawal from the study may also be considered throughout the study at any time by clicking the 'X' and closing the page on screen as stated within the information page (Appendix 1), informed consent page (Appendix 2) and debrief page (Appendix 6). Lastly, the participants will also be provided with the contact details of the researcher which may be used if the participant has any queries, questions or concerns.

In terms of confidentiality, participants will only be rating words which will be done anonymously which would eliminate any chance of the participant being identified. Also for safety and security measures, participants will not be able to continue without completing the consent page and confirming that they are 18 or over. Additionally, the results will only be accessed by the researcher and supervisors.

19. Have participants been/will participants be, fully informed of the risks and benefits of participating and of their right to refuse participation or withdraw from the research at any time?

YES (Outline your procedures for informing participants in the space below).

To tackle the issues of participants' rights, the participants will all be shown an information page (See appendix 1) that will discuss and highlight stages of the study, reasons for conducting it and so on. The information page (Appendix 1) will be used to guide the participants on any potential concerns(i.e. being exposed to words with negative meanings that may evoke similar feelings). The use of these words will also be explained in terms of their role and their importance and how they are general 'everyday' words which shouldn't overall cause much problems.

In addition to this the right to withdraw has also been mentioned in the information page (Appendix 1),the consent form page (Appendix 2) and the debrief page (Appendix 6).Participants may withdraw at any point within the study, up until the actual submission of the participant sheets as afterwards it would be impossible to single out data due to anonymity. Additionally data will not be continued with if the participant withdraws and would be deleted straightaway.

An informed consent page (See appendix 2) will also be shown to participants, which will reiterate important points of the study that the participant needs to know in order to take part in the study. Only by ticking all the boxes and giving their full consent will they proceed with the pilot study. Participants will not be allowed to continue if they do not fill this page or state that they are under the age of 18. The informed consent (Appendix 2) will be a means of fully comprehending risks involved.

Once the study is complete, the participants will be then shown a debrief page(Appendix 6) so that they fully understand the nature of the study. The debrief page (Appendix 6) will explain reasons behind this pilot study alongside highlighting the participants right to withdraw. The debrief (Appendix 6) will also hold contact details for the university's counselling services and the 'Samaritans' alongside contact details of the researcher.

20. Are participants in your study going to be recruited from a potentially vulnerable group? (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of vulnerable groups)

NO

21. How will you ensure that the identity of your participants is protected (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for guidance on anonymity)

Participants will be protected and anonymity will be ensured by making sure that participants cannot be identified through their data by ensuring that no identifiable data is given by the participant on their data sheet which may be a cause of concern.

22. How will you ensure that data remains confidential ((See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of confidentiality)

Confidentiality will also be followed throughout the experiment by ensuring that no unauthorised individuals may have access to participant data. Only the researcher and supervisors will have access to the data. Additionally the data will be stored and kept within a password protected computer, which will obstruct and stop any mishandling of data or unnecessary handling of data.

23. How will you store your data during and after the project? (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of and guidance on data protection and storage).

Any data collected within this study will be safely stored and handled. Any online data will be kept on a password protected computer and any possible hard copies of data or raw data will be kept in a room that is locked and only available to the researcher and supervisors. All this data will be kept untilthe completion of the PhD where there is a possible chance of it being published if the data is viable. After this the data will be destroyed securely and confidentially.

24. Append study documentationto this form (Please append below the materials you will use to carry out your study. These should typically include letters of contact, consent forms, information sheets,

data collection materials (e.g. interview schedules, surveys, experimental materials, training and intervention materials etc.), debrief and, if appropriate, a risk assessment document/lone worker policy.)

Experiment 4-

ETHICS APPLICATION FORM:
PSYCHOLOGY, HEALTH, SOCIAL WORK & SOCIAL CARE

1. Please enter your surname and first name below. (SURNAME, FIRST NAME)
Ahmed, Sumera

2. Please enter your University e mail address (e.g. M.Name@wlv.ac.uk)
[e-mail address redacted]

3. Please enter the name of your Project Supervisor, Director of Studies, or Principal Investigator.
Dr. Tom Mercer andDr. Danny Hinton

4. Please enter date by which a decision is required below. (Note that decisions can take up to 4 working weeks from date of submission)
Within four working weeks of submission

5. Which subject area is your research / project located?
Health and Wellbeing (including Psychology)

6. Please select your Faculty, Department or Research Centre
Faculty of Education Health and Wellbeing

7. Does your research fit into any of the following security-sensitive categories? (For definition of security sensitive categories see RPU webpages (www.wlv.ac.uk/rpu) follow links to Ethical Guidance).

Not applicable

8. Does your research involve the storage on a computer of any records, statements or other documents that can be interpreted as promoting or endorsing terrorist acts?

2. NO

9. Might your research involve the electronic transmission (eg as an email attachment) of any records or statements that can be interpreted as promoting or endorsing terrorist acts?

NO

10. Do you agree to store electronically on a secure University file store any records or statements that can be interpreted as promoting or endorsing terrorist acts. Do you also agree to scan and upload any paper documents with the same sort of content. Access to this file store will be protected by a password unique to you. Please confirm you understand and agree to these conditions?

YES I understand and agree to the conditions

11. You agree NOT to transmit electronically to any third party documents in the University secure document store?

YES I agree

12. Will your research involve visits to websites that might be associated with extreme, or terrorist, organisations? (for definition of extreme or terrorist organisations see RPU webpages (www.wlv.ac.uk/rpu) and follow links to Ethical Guidance.

NO

13. You are advised that visits to websites that might be associated with extreme or terrorist organisations may be subject to surveillance by the police. Accessing those sites from university IP addresses might lead to police enquiries. Do you understand this risk?

YES I understand

14. What is the title of your project?

Directed forgetting and the impact of external factors

15. Briefly outline your project, stating the rationale, aims, research question / hypothesis, and expected outcomes.

This project intends to further look at intentional forgetting in relation to emotion, stimuli of different valences and individual factors (Mood and emotional reactivity)

Forgetting is often considered as something that is a result of faultyencoding or consolidation failure. However, this only explains forgetting in terms of the forgetting that is done accidentally or unintentionally,whereas forgetting can be done intentionally too. The concept of intentional forgetting is examined in more detail through the paradigm of 'Directed Forgetting' (Bjork,1970), which works by telling participants to remember some stimuli (the TBR information) and forget others (the TBF information). In a subsequent memory test, participants are much more likely to remember TBR than TBF stimuli (Sahakyan& Foster, 2009).

However, there are mixed results concerning directed forgetting of emotional stimuli. For example,emotional materialmay be recalled better than neutral material as well as negatively valenced stimuli being better recalled than positive or neutral (Cacioppo&Gardner,1999), regardless of the instruction. This dispute amongst valence and recall brings a further division within directed forgetting as it becomes harder to decipher what can be intentionally forgotten and what cannot. In fact, most studies seem to use stimuli that has been used numerous times, such as stimuli from the ANEW database (Bradley & Lang, 1999) yet still have different results. Thus the question that arises is whether the stimuli being used in these studies may beproblematic or under-researched.

In consideration to the stimuli itself, research has argued that within studies that use words in cognitive tasks, there is potential that the type of word will affect the task. This can be better explained through 'abstract' and 'concrete' words. 'Abstract' is the term used to define words that are related to thoughts, qualities, ideas and so on whereas 'concrete' is the term that defines things that can be sensed through the five physical senses.Research that looks at concrete and abstract words has focused on many areas from lexical processing (Schwanenflugel, Harnishfeger& Stowe, 1988), frequency (Galbraith & Underwood, 1973), processing and diagnosed disorders (Crutch, Ridha& Warrington, 2006) and lastly general memory (Walker &Hulme, 1999). However there seems to be a gap within literature in regards to the effect of these words in terms of memory when valence comes in to the equation. This is particularly important to consider as it may be a defining factor in regards to why the results may differ within forgetting or more specifically in directed forgetting studies. Not only this but to fully consider the impact valence may have, mood and emotional reactivity are also strong contenders and possible influencers. This then leads to considering and also measuring mood within this study as mood is known to influence cognition and feelings (Rottenberg, 2005) by modulating reactions that are linked to emotion (Rosenberg, 1998). Therefore, all these variables will be considered and looked at within the act of directed forgetting to see the full impact of categorisedstimuli, valence and forgetting.

Additionally another factor that may influencedirected forgetting is time, as some research has suggested that unneeded information and the burden of such information lessens over time through the process of 'active decay' (Hardt, Nader &Nadel, 2013). In terms of directed forgetting, it would be interesting to see how time would affect the relationship of recall and the emotional stimuli in regards to whether it would further consolidate the stimuli or help to forget it. Therefore time will be another element that will be added within this experiment.

In consideration of the previously discussed research it is imperative that directed forgetting be looked at against the context of the actual stimuli being used in the form of the two domains of 'abstract' and 'concrete' words alongside all three valences (negative, neutral and positive). Mood and emotional reactivity scales will also be used to test out individual differences and how these all impact each other. The experiment will focus on the item method of DF and how these two type of stimuli impact recall when they are further categorised within three valences (positive, neutral and negative), especially when there is a time delay in one group and not the other. Thus in relation to all this the following hypotheses will be tested:

H1) Participants will be able to better recall TBR cue associated words than words that are related to the TBF cue.
H2) Participants will be able to better recall words that are more emotionally valenced than words that are neutrally valenced. Additionally participants will be more likely to recall words are negatively valenced in comparison to those that are positively valenced.
H3) Participants will be more likely to recall words that are ' concrete' in nature than the words that are ' abstract' in nature.
H4) Participants will be more likely to recall more words when there is no gap in comparison to when there is a gap.
H5) Participants will be more likely to recall the emotional words when there is a delay in comparison to recalling the neutral words.
H6) Participants will be better able to recall emotional words when there is a TBF cue in comparison to recalling neutral words.
H7) Participants will be better able to recall words that are 'concrete ' in nature than those that are 'abstract' when there is a TBF cue present.
H8) Participants will be better able to recall words that are 'concrete ' in nature when there is a delay in comparison to recalling 'abstract ' words in a delay.
H9) Participants will be better able to recall words that are negatively valenced and 'concrete ' in comparison to recalling words that are neutral and ‘abstract ' in nature.
H10) Participants who have been rated high on 'emotional reactivity' and 'negative mood' will be more likely to recall TBF words that are emotional than the participants who have been classed as low 'emotional reactivity'.

16. How will your research be conducted?
Describe the methods so that it can be easily understood by the ethics committee. Please ensure you clearly explain any acronyms and subject specific terminology. Max 300 words

This experimental study which will be using a mixed measures design.The study will use opportunity sampling to recruit psychology undergraduate students through a research methods module.Participants will be a part of a 'practical'session, where they will take part in the study and then analyse results as part of the module requirement. A minimum of 150-200 students are expected to take part, yet due to the classroom setting, the amount participating will fluctuate based on student attendance [1].

Participants will arrive in the designated room where they will be seated and handed the information sheet (Appendix 1& 2) followed by a consent form (Appendix 3)which will have to be signed in order for further participation. A demographics questionnaire (Appendix 4) will also be given to obtain sample information.This will then be followed up with a mood questionnaire (PANAS- Watson, Clark &Tellegan, 1988 [Appendix 5]) and an Emotional reactivity questionnaire (PERS- Becerra&Campitelli, 2013 [Appendix 6]). After this the researcher will use PowerPointto show the wordsadapted from the previous pilot study (Pilot rating of concrete/ abstract words; Appendix 7). The words will include a mixture of abstract and concrete items divided into positive, negative and neutral valences. Each word will be followed by an instructionalcue (TBR or TBF, Appendix 8 & 9) shown for 1.5 seconds. After all the words have been shown, participants will be asked to recall as many words as they can on a recall sheetwhere based on the group they are in, will either recall after a 10-minute(delay) or straightaway(no delay [Appendix 10]). The study will be concluded with a debrief sheet (Appendix 11) and verbal overview of the experiment.

Analysis will be done through SPSS using a mixed ANOVA and regressions.

17. Is ethical approval required by an external agency? (e.g. NHS, company, other university, etc.)

NO

18. What in your view are the ethical considerations involved in this project? (e.g. confidentiality, consent, risk, physical or psychological harm, etc.) Please explain in full sentences. Do not simply list the issues. (Maximum 1000 words)

In this study though ethics have been fully considered and though care has been maintained in order to have the study presented in a careful manner there are still some considerations. Firstly, it is the use of deception that takes place. The study demands a mild form of deception to take place as the study is looking at memory. This form of deception is where participants will be told that they need to remember just the 'To Be Remembered/TBR' words whereas in fact they will be asked to recall words from both 'To Be Remembered' and ‘To Be Forgotten/TBF' categories. This deception, however, has been fully explained in the debrief sheet (See Appendix 11) which outlines and explains the nature of the study, what actually happened and what was expected of them as participants. If after the debrief sheet (See Appendix 9) is given the participant feels unhappy with the procedure, then they can ask to have their data removed. The right to withdraw has been explained in the information sheets (See Appendix 1& 2) and the debrief sheet(See Appendix 11).

Additionally due to deceptiontaking place, the participants will not be fully able to give their consent (See Appendix 3). However, this will all be explained within the debrief sheet (See Appendix 11) alongside the opportunity to withdraw if they feel they cannot fully commit. Furthermore, information within the information sheet (See Appendix 1& 2) will explain the procedure correctly which will undoubtedly remain the same as participants are just remembering and recalling words.

In terms of the actual experiment, though the words being used are 'everyday' words that are dealt with ona daily basis (See Appendix 7),there are chances that participants may feel these words evoking feelings that are representational of their underlying affective connotation that may cause some form of displeasure. However, this has been dealt with by explaining the reason behind using these words in the information sheet (See Appendix 1& 2) and in the informed consent form (SeeAppendix 2) where without the participants full understanding and consent they will not be able

to continue. Not only this but for precautionary measures the University's Counseling Services details have been printed on the debrief sheet (See Appendix 11) alongside contact details of the researcher, in case the participant feels the need to use these. However once again if the participant feels uncomfortable at any point then they may withdraw from the study (as mentioned in the information sheet [See Appendix 1& 2], informed consent sheet [See Appendix 3] and debrief sheet [See Appendix 11])

Looking at the issue of confidentiality, participants will be asked to write words on a word recall sheet (See Appendix 10) and fill in two questionnaires (See Appendix 5 &6). This has the potential risk of being lost, misplaced or the participant being identified. Thus to avoid any of the mentioned issues, all participant related material will be kept in a safe place where only researcher and supervisors will have access. Additionally any raw data collected will also be kept on a password protected computer which once again will only be accessed only by the researcher and supervisors. Furthermore, the consent forms (See Appendix 3), the task recall sheets (See Appendix 10) and the questionnaires (See Appendix 5 & 6) will be kept separately in order to eliminate the risk of the participants being identified and keeping their answers anonymous.In addition, some of the data will be returned to participants for analysis in taught workshops. To ensure that anonymity is maintained, fictional demographic data will be given to the students, preventing specific individuals from being identified.

Finally, as the study is part of a module, it is important to ensure that participants have a choice to participate and do not feel obligated to do so. The option to not take part will be clarified verbally by the experimenter and again in the information sheet and consent form.

19. Have participants been/will participants be, fully informed of the risks and benefits of participating and of their right to refuse participation or withdraw from the research at any time?

YES (Outline your procedures for informing participants in the space below).

Participants will be handed an information sheet (See Appendix 1& 2) which will inform them about the study. The sheet will look at information such as who is doing the study, what will happen and so on. It will also outline the importance of understanding the study including potential minor risks involved and general advantages of taking part. The information sheet (See Appendix 1& 2) will also highlight the stimuli and the risk of exposure to words with underlying affective connotations (positive, negative and neutral) that may evoke feelings in association with certain words(See Appendix 7). However it has also been stressed that these are everyday words and shouldn't be such a big concern for the participant.

Additionally, it has been explained in the Information sheet (See Appendix 1& 2) that if the participant still feels uncomfortable with the experiment or the words then they may withdraw at any time before or during data collection. Withdrawal from the participant is onlyallowed up until the point that data is submitted at the end of the experiment due to the anonymous nature of the data. If the participant does decide to withdraw then from that point no data of theirs will be proceeded with.

A consent form (See Appendix 3) will also be issued to each participant which will once again highlight important issues within the study, where participants will give their full consent for the study by signing the sheet as it will be the only means of participation as this will point out that the participant fully understands the study and any risks involved.

After the completion of the study, participants will also be handed a debrief sheet (See Appendix 11 which will explain the actual intent of the study. This debrief sheet (See Appendix 11) will highlight and make the participant fully aware of any problems they may have encountered within the study as well as highlighting any deceit that may have occurred. This will also include explaining why participants had to recall words from both the 'To Be Remembered' and 'To Be Forgotten' list as opposed to what they were told initially which was to remember just the 'To Be Remembered' words. The debrief (See Appendix 11) will also reiterate the participants right to withdraw and reassure the participant on the anonymous and confidential nature of the experiment and data collected. Additionally, the debrief (See Appendix 11) will hold details of the University's counselling services and how the participant can go about contacting them,if need be (See Appendix 4).

20. Are participants in your study going to be recruited from a potentially vulnerable group? (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of vulnerable groups)

NO

21. How will you ensure that the identity of your participants is protected (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for guidance on anonymity)

Thedata produced within this experiment and study will protect participant identities and anonymity by ensuring that there is no direct or clear link from data to participant. This will be done by participants not giving out identification means through names or any other information.

22. How will you ensure that data remains confidential ((See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of confidentiality)

Confidentiality will be maintained throughout the experiment as there will be no sharing of data to anyone or third parties. Individuals with access to the confidential information will include the researcher and the supervisor(s). However, this will also be limited as all digital data will be processed and saved on a password protected computer and raw data willbe kept in a room that is locked.

23. How will you store your data during and after the project? (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of and guidance on data protection and storage).

During the project all information and data will be safely stored where the storage and handling of digital data will be on a password protected computer and the rest of the raw data to be stored safely in a room that is locked and only accessible to the researcher and supervisor(s) where no unauthorised individual may access this data. The period of storage for such data and documents isfor the duration of the PhD (approximately 3-4 years), whereon after all the data will be destroyed confidentially. It is also of importance to mention that there is a possibility of the results being published if they are considered viable.

24. Append study documentationto this form (Please append below the materials you will use to carry out your study. These should typically include letters of contact, consent forms, information sheets, data collection materials (e.g. interview schedules, surveys, experimental materials, training and intervention materials etc.), debrief and, if appropriate, a risk assessment document/lone worker policy.)

Experiment 5-

Ethics Submission Form 2018
Faculty of Education, Health and Well-being

- *You must complete all sections of this form in as much detail as possible. (word counts are given if necessary) If your form is incomplete, it will be returned to you to resubmit.*
- *You must be given approval for your research project from the University before you can begin.*
- *Applications should be submitted by 1st Monday of each month to FEHWResearch@wlv.ac.uk*

SECTION ONE

1. Enter Your First Name and Surname Below:	
First Name	Sumera
Surname	Ahmed

2. Enter your University Student/ Number
1208623

3. Enter your University e mail address (e.g. M.Name@wlv.ac.uk)
[e-mail address redacted]

4. Enter your daytime contact telephone number in case we need to contact you.
[number redacted]

5. Enter the name of your Project Supervisor, Director of Studies, or Principal Investigator.
Dr. Tom Mercer

6. Which subject area is your research / project located? Please ✓ all that apply

1	FEHW	✓
2	Education	
3	Health	
4	Sport	
5	Psychology	✓
6	FSE	
7	FOSS	
8	FOA	
9	COLT	
10	Cross University Project	

	Other – Please give details below:	

8 Please indicate if this study is	
	✓
Staff Research (Externally funded)	
Staff Research (University funded)	

8. Which Category of Project Are You Applying For? Categories are outlined in the handbook from the RPU (www.wlv.ac.uk/rpu) Please tick✓					
Category A					

9. Give details of service user involvement
N/A

SECTION TWO

10. What is the title of your project?
Influential stimuli and directed forgetting

11. Give details of any proposed research questions/hypothesis
H1) Participants will be able to better recall TBR (to be remembered) cue associated words than words that are related to the TBF (to be forgotten) cue. H2) Participants will be more likely to recall words from the emotion categories: 'sexual' and 'abuse' categories in comparison to the words from the generic categories (body and 'house hold objects). H3) Participants will be more likely to have a better recall of words when there is a shorter gap that is associated with them in comparison to when there is a longer gap. H4) Participants will be more likely to recall the sexual words as opposed to recalling the other three categories when there is a longer gap. H5) Participants will be more likely to recall the sexual words when there is a TBF cue in comparison to recalling the other words. H6) Participants will be more likely to recall the words from the 'emotion' categories in comparison to the 'neutral' categories when there is a TBF cue present. H7) Participants will be more likely to recall the words from the 'emotion' categories when there is a longer delay in comparison to recalling the 'neutral' categories.

12. Briefly outline your project, stating the rationale, aims and expected outcomes. (300 words)

This project intends to further look at intentional forgetting in relation to properties related to the category of the stimulus.

Forgetting is often considered as something that is accidental or unintentional, whereas research has shown that forgetting can be intentional too. The concept of intentional forgetting is examined in more detail through the paradigm of 'Directed Forgetting' or DF (Bjork, 1970), which works by telling participants to remember some stimuli (the TBR information) and forget others (the TBF information). In a subsequent memory test where participants have to remember all stimuli, they are much more likely to remember TBR than TBF stimuli (Sahakyan& Foster, 2009).

However, there are mixed results concerning DF of emotional stimuli. There is a general dispute concerning what can be intentionally forgotten, and this may be down to valence differences and preferences within recall (Cacioppo & Gardner, 1999). This may also be a consequence of the stimulus itself where even by using the same databases each time for stimul, results differ. Therefore, it can be questioned as to whether the stimuli being used is appropriate or not and whether that is a major component of directed forgetting that is under researched. Additionally, research suggests that categorisation of information or stimuli is highly important for cognition (Harnad, 2005). It can be argued that some categories are processed better than others due to their properties (Brosch, Pourtois, & Sander, 2010). Thus in accordance with this idea, having stimuli categorised within a DF experiment could impact the way items are recalled which may shed some light on why there are conflicting findings within DF and previous research. Overall, it is imperative to research DF against this context to fully understand intentional forgetting.

12. How will your research be conducted? (750 words max.)
Describe the methods so that it can be easily understood by the ethics committee. Please ensure you clearly explain any acronyms and subject specific terminology.

This experimental study will be using a repeated measures design. The study will use opportunity sampling to recruit psychology undergraduate students through the university's recruiting portal SONA. A minimum of 50 students will be recruited.

Participants will arrive in the designated room where they will be seated and handed the information sheet (Appendix 1) followed by a consent form (Appendix 2). The consent form will have to be signed in order for further participation. A demographics questionnaire (Appendix 3) will also be given to obtain sample information. This will then be followed by words being presented on a computer screen using the software 'Super Lab V5'. The words are adapted from the ANEW database (Bradley & Lang, 1999). The words will be categorised into the following: 'sexual', 'abuse', 'household objects' and body' related words (Appendix 4). Each word will be followed by an instructional cue (TBR or TBF [Appendix 5& 6]) shown for 1.5 seconds. After all the words have been shown, participants will be asked to recall as many words as they can on a recall sheet regardless of cue

(Appendix 7). The study will be concluded with a debrief sheet (Appendix 8) and verbal overview of the experiment.

13. How will your data be analysed?

Analysis will be done through SPSS using a repeated measures ANOVA.

14. Is ethical approval required by an external agency? (e.g. NHS, company, other university, outside organisation, etc.)

1. NO

15. What in your view are the ethical considerations involved in this project? (e.g. confidentiality, consent, risk, physical or psychological harm, etc.) Please explain in full sentences. Do not simply list the issues. You should also make it clear how you are going to deal with issues with regard to your own welfare and safety.

Areas	✓	Intervention
Confidentiality	✓	Participants will be asked to write words on a word recall sheet (See Appendix 7). This has the potential risk of being lost, misplaced or the participant being identified. Thus to avoid any of these mentioned issues, all participant-related material will be kept in a safe place where only researcher and supervisors will have access. Additionally any raw data collected will also be kept on a password protected computer which once again will only be accessed only by the researcher and supervisors. Furthermore, the consent forms (See Appendix 2) and the word recall sheets (See Appendix 7) will be kept separately in order to eliminate the risk of the participants being identified and ensure full anonymity.
Consent	✓	Additionally due to some mild deception, the participants will not be fully able to give their full consent (See Appendix 2). However, this will all be explained within the debrief sheet (See Appendix 8) alongside having the opportunity to withdraw. Furthermore, details within the information sheet (See Appendix 1) will explain the procedure which will remain the same as participants are just remembering and recalling words.

Deception	✓	Though all these ethical issues have been fully considered and though care has been maintained there is a mild form of deception as the study is looking at memory. Here participants will be told that they need to remember just the 'To Be Remembered/TBR' words whereas in reality they will be asked to recall words from both 'To Be Remembered' and 'To Be Forgotten/TBF' categories (See Appendix 4). This deception, however, has been fully explained in the debrief sheet (See Appendix 8) which outlines and explains the real nature of the study. However if after reading the debrief sheet (See Appendix 8) the participant feels unhappy with the study then they can ask to have their data removed. The right to withdraw has been explained in the information sheet (See Appendix 1) and the debrief sheet(See Appendix 8).
Stimuli	✓	The words being used are 'everyday' words that are used on a daily basis (See Appendix 4), but there may be chances that the participants may feel these words evoke feelings that are representational of their underlying meanings that may cause some form of displeasure. However, the reason for using these words has been explained in the information sheet (See Appendix 1). Additionally the informed consent form (See Appendix 2) has been used to take the participants full consent and give them an understanding as to what they are going to be doing which needs their full consent. Not only this but for precautionary measures the University's Counselling Services details have been printed on the debrief sheet (See Appendix 8) alongside contact details of the researcher, in case the participant feels the need to use these. However once again if the participant feels uncomfortable at any point then they may withdraw from the experiment (as mentioned in the information sheet [See Appendix 1], informed consent sheet [See Appendix 3] and debrief sheet [See Appendix 8]).

16. Have participants been/will participants be, fully informed of the risks and benefits of participating and of their right to refuse participation or withdraw from the research at any time?
1. YES (Outline your procedures for informing participants in the space below.)
Participants will be handed an information sheet (See Appendix 1) which will inform them about the study. The sheet will provide information that is related to the study,from the procedure to the reasons behind it. It will also outline any potential minor risks and general advantages of taking part. The information sheet (See Appendix 1) will also highlight the stimuli and the risk of coming across words with negative connotations. However it has also been stressed that these are everyday words and shouldn't be of big concern for the participant.

Additionally, it has been explained in the Information sheet (See Appendix 1) that if the participant feels uncomfortable at any point then they may withdraw at any time before or during data collection. Withdrawal from the participant is only allowed up until the point that data is submitted at the end of the experiment due to the anonymous nature of the data. If the participant does decide to withdraw then from that point no data of theirs will be proceeded with.

A consent form (See Appendix 2) will also be issued to each participant which will once again highlight important issues within the study, where participants will give their full consent for the study. Signing the sheet will be the only means of participation as this will ensure that the participant fully understands the study and any risks involved.

After the completion of the study, participants will also be handed a debrief sheet (See Appendix 8) which will explain the actual intent of the study. The debrief sheet (See Appendix 8) will generally highlight and explain any problems the participants may have encountered within the study. This will also include explaining why participants had to recall words from both the 'To Be Remembered' and 'To Be Forgotten' list as opposed to initial instructions of remembering just the 'To Be Remembered' words. The debrief (See Appendix 8) will also reiterate the participants right to withdraw and reassure the participant on the anonymous and confidential nature of the experiment and data collected. Additionally, the debrief (See Appendix 8) will hold details of the University's counselling services, if need be (See Appendix 8).

17. How will you ensure that the identity of your participants is protected (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for guidance on anonymity)

The data produced within this experiment and study will protect participant identities and anonymity by ensuring that there is no direct or clear link from data to participant. This will be done by participants not giving out identification means through names or any other information.

18. How will you ensure that data remains confidential ((See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of confidentiality)

Confidentiality will be maintained throughout the experiment as there will be no sharing of data to anyone or third parties. Individuals with access to the confidential information will include the researcher and the supervisor(s). However, this will also be limited as all digital data will be processed and saved on a password protected computer and raw data willbe kept in a room that is locked.

19. How will you store your data during and after the project? (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of and guidance on data protection and storage).

During the project all information and data will be safely stored where the storage and handling of digital data will be on a password protected computer and the rest of the raw

data to be stored safely in a room that is locked and only accessible to the researcher and supervisor(s). No unauthorised individual may access this data. The period of storage for such data and documents is for the duration of the PhD (approximately 3-4 years), whereon after all the data will be destroyed confidentially. It is also of importance to mention that there is a possibility of the results being published if they are considered viable.

SECTION THREE

The following questions must be answered otherwise your form will not be reviewed and it will need to be resubmitted to the panel at a later date.

20. Does Your Research Involve Children Under 18 years of Age? Please delete and leave your response below
3. No
If Yes, Do you have an Enhanced Disclosure Certificate from the Criminal Records Bureau/Disclosure and Barring Service (DBS)?

21. Are participants in your study going to be recruited from a potentially vulnerable group? (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of vulnerable groups)
2. NO

22. Does your research fit into any of the following security-sensitive categories? (For definition of security sensitive categories see RPU webpages (www.wlv.ac.uk/rpu) follow links to Ethical Guidance). If so please complete questions 22-26

	Security Sensitive Categories	If YES, please tick below. ✓	If NO, please tick below. ✓
1	Commissioned by the military		✓
2	Commissioned under an EU security call		✓
3	Involve the acquisition of security clearances		✓
4	Concerns terrorist or extreme groups		✓

23. Does your research involve the storage on a computer of any records, statements or other documents that can be interpreted as promoting or endorsing terrorist acts? Please delete and leave your response below.
1. NO

24. Will your research involve the electronic transmission (e.g. as an email attachment) of any records or statements that can be interpreted as promoting or endorsing terrorist acts? Please delete and leave your response below.
NO

25.Do you agree to store electronically on a secure University file store any records or statements that can be interpreted as promoting or endorsing terrorist acts. Do you also agree to scan and upload any paper documents with the same sort of content? Access to this file store will be protected by a password unique to you. Please confirm you understand and agree to these conditions.
1. YES I understand and agree to the conditions

26. Do you agree NOT to transmit electronically to any third party documents in the University secure document store?
1. YES I agree

27. Will your research involve visits to websites that might be associated with extreme, or terrorist, organisations? (for definition of extreme or terrorist organisations see RPU webpages (www.wlv.ac.uk/rpu) and follow links to Ethical Guidance.
2. NO

28. You are advised that visits to websites that might be associated with extreme or terrorist organisations may be subject to surveillance by the police. Accessing those sites from University IP addresses might lead to police enquiries. Do you understand this risk?
1. YES I understand

29. Appendices (All submissions) Please list the items that you are submitting with this document. (These will need to be submitted to FEHWResearch@wlv.ac.uk) You may want to include additional information that will help the panel with their decision such as your proposal. You need to provide examples of research instruments, recruitment posters and leaflets, information sheets (age appropriate) assent forms (for children), consent forms, risk assessment if research is carried out abroad .

Appendix 16 – Confirmation of Ethics approval

Dr Alexandra Hopkins RN PhD MSc MBA RNT RCNT DANS
Dean of the Faculty of Education Health and Wellbeing

University of Wolverhampton
Millennium City Building
City Campus Wulfruna (South)
Wolverhampton
WV1 1LY

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UK: 01902 Abroad: +44 1902

Switchboard: 321000

Internet: www.wlv.ac.uk

28/01/2020

RE: Ethical approval

Dear examiners,

This letter is to confirm that all of Sumera Ahmed's PhD experiments were reviewed by a Faculty Ethics Committee. All experiments were approved. In some cases, approval was dependent on cert amendments being made, which were checked by the supervisory team before recruitment for each experiment began. Unfortunately, ethical approval was confirmed in emails that are no longer available, but I hope this information helps confirm that the process was adhered to throughout the PhD.

Yours sincerely,

Dr Tom Mercer, CPsychol, AFBPsS, FHEA
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